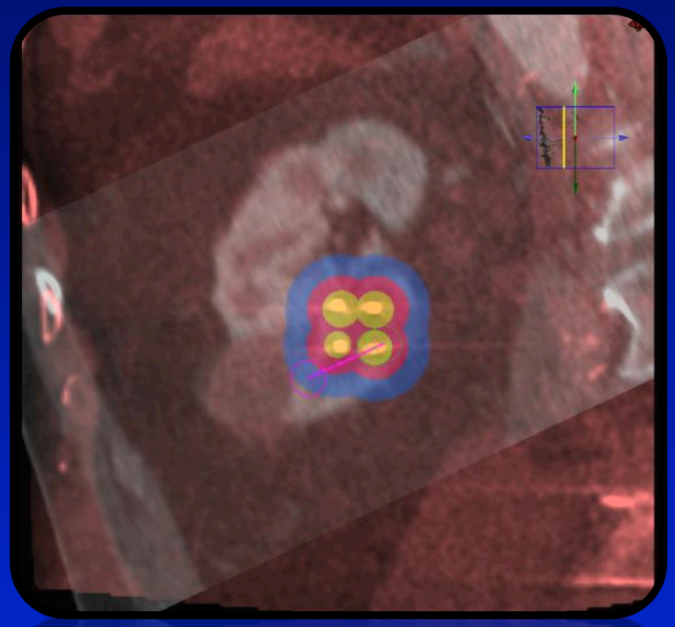
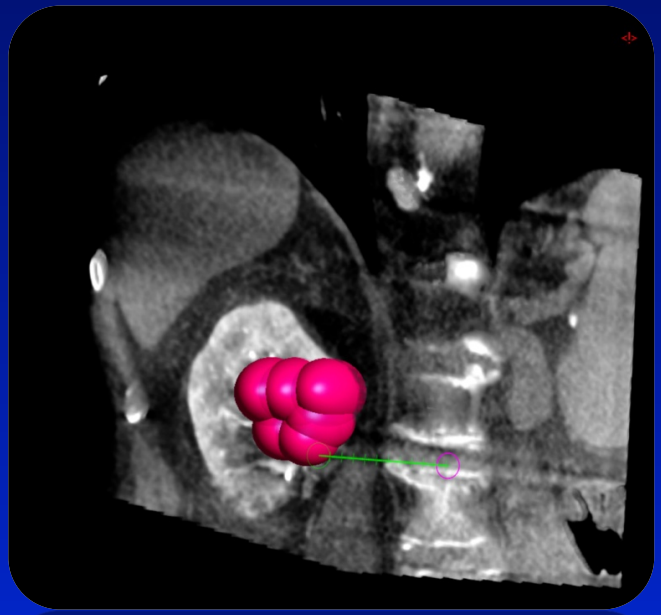
The next step in percutaneous needle interventions





New tools in image guidance in intervention

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Department of Interventional Radiology

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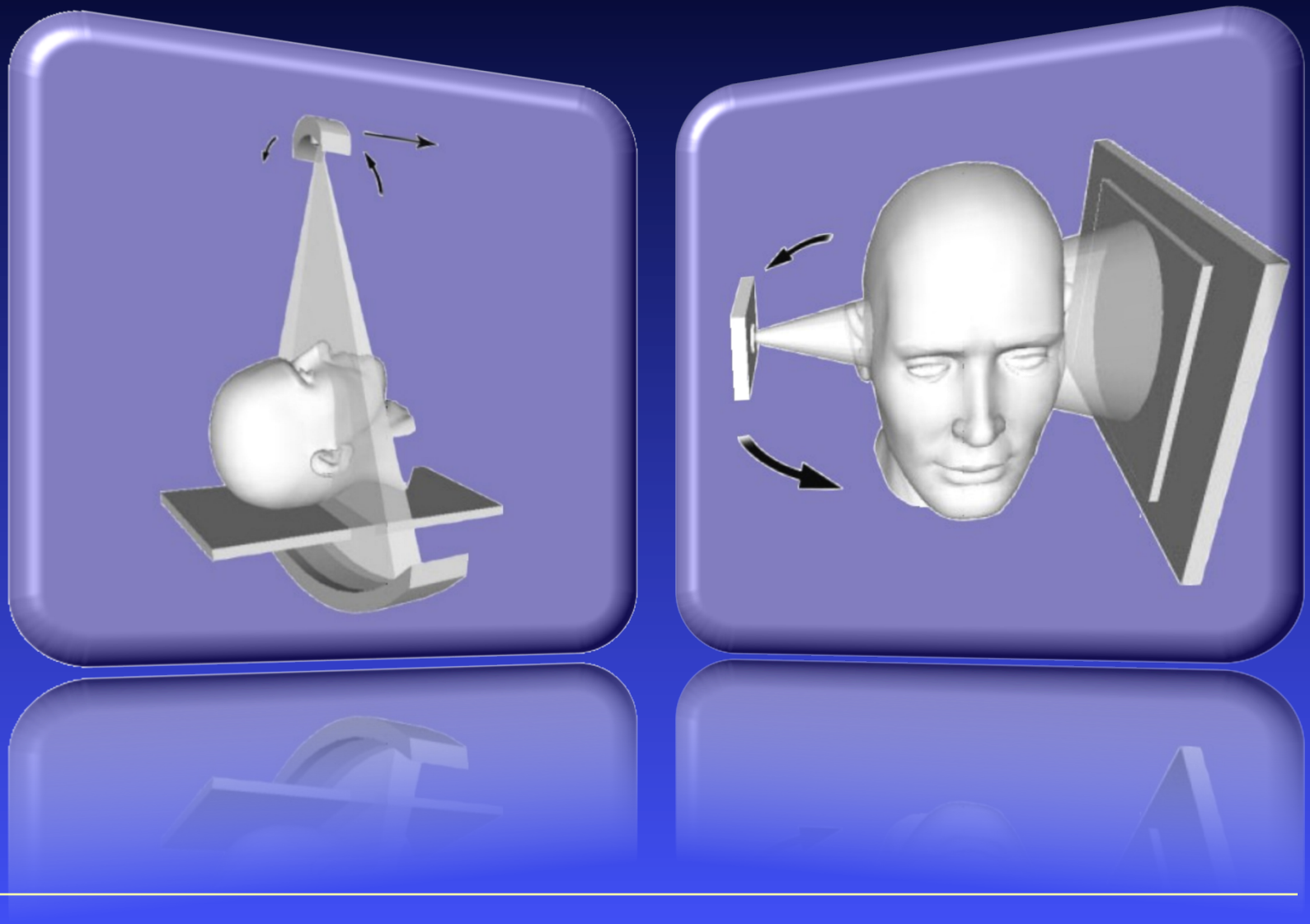
Conebeam CT (CBCT)

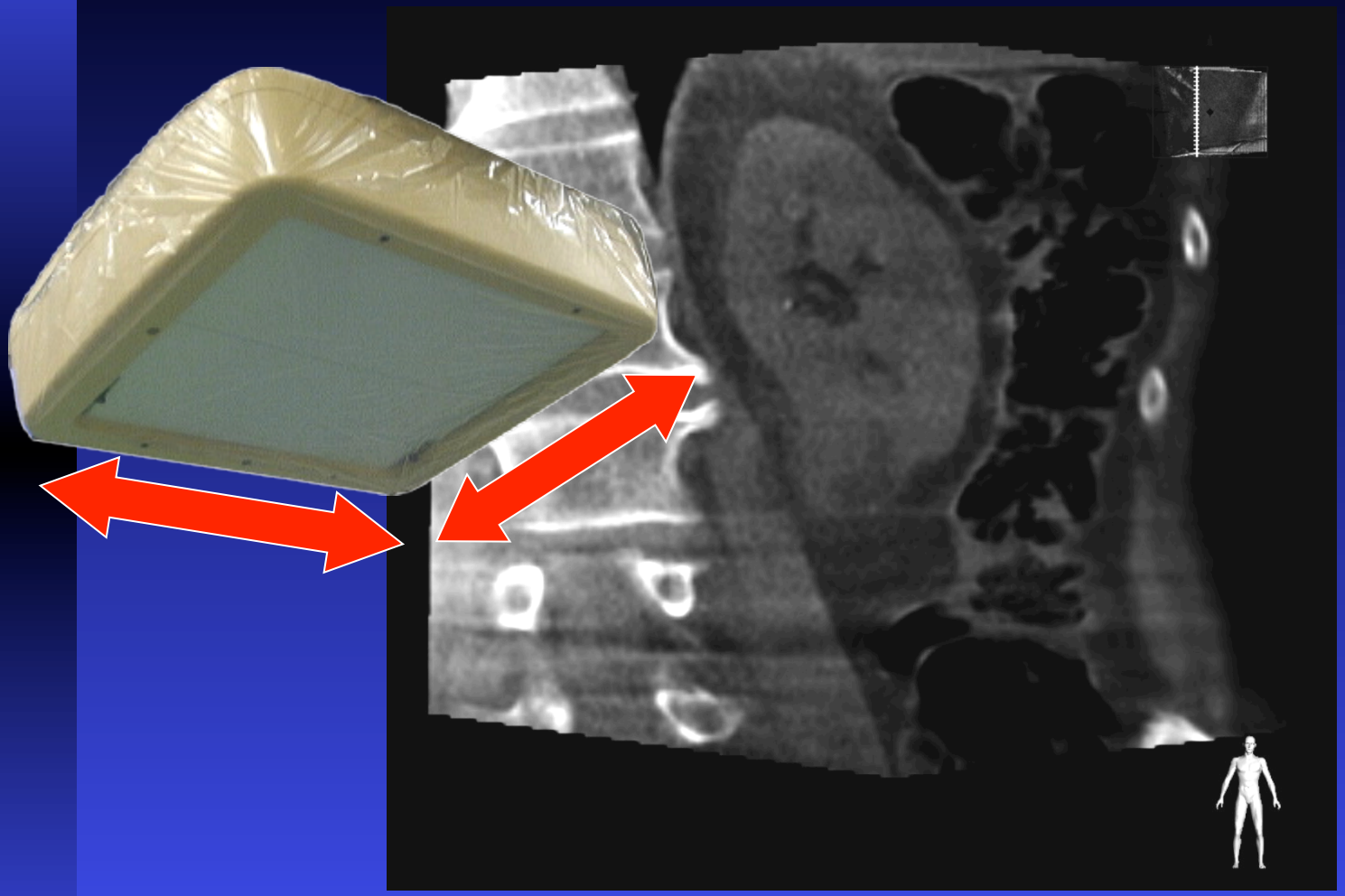
CBCT

- Availability of cross-sectional imaging in the angio suite
- Additional information to fluoroscopy
- Dedicated needle guidance
- Registering tool for using 3D overlay
- Complication evaluation/management in needle interventions

Cone beam CT

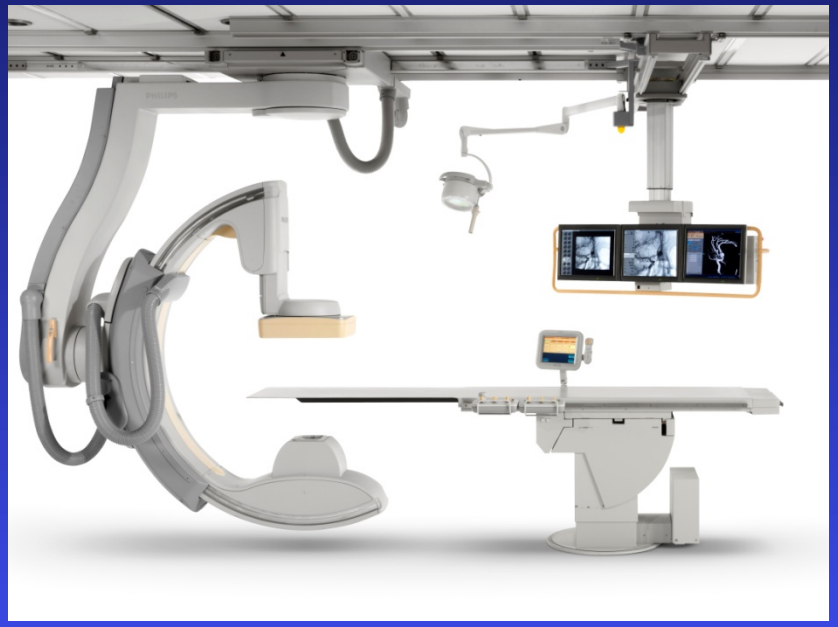


Cone Beam CT



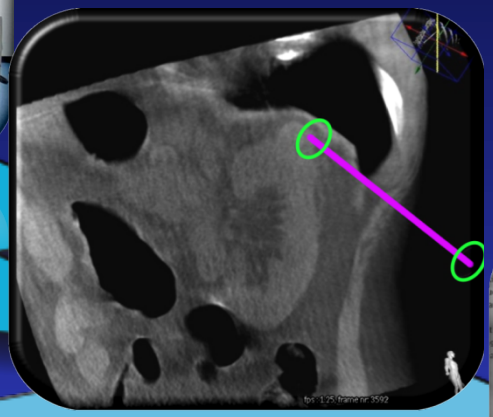
Detector 38 x 30 cm Voxel size 0.4 mm isocentric

XperGuide procedure



CBCT procedure

XperCT (conebeam CT)



Diagnostic biopsies

Needle interventions

Co-registering

Preparation

- XperCT scan

Planning

- virtual path from incision position to lesion

Positioning

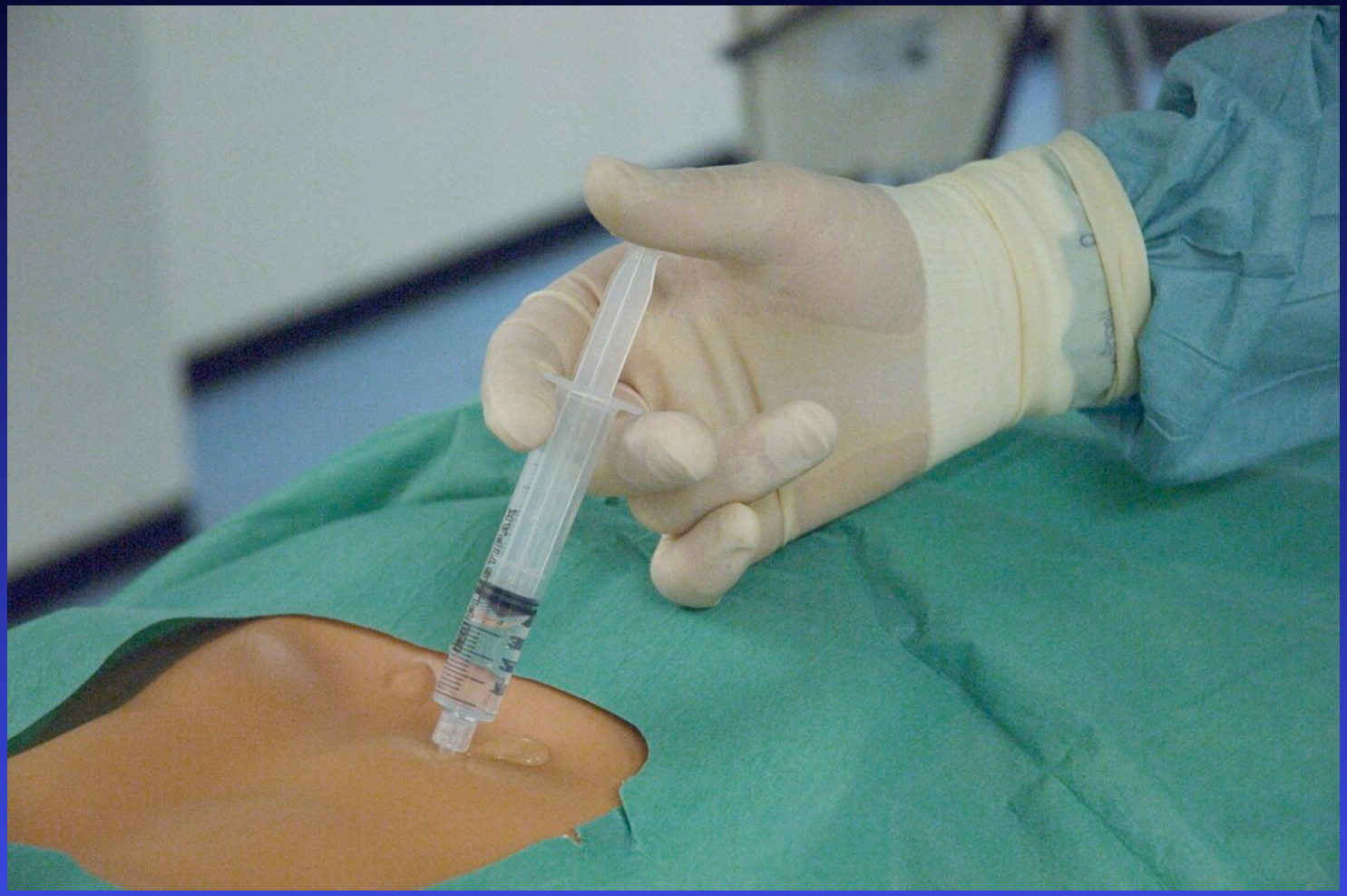
- Calculated positions reached with one button
- Simple switching between C-arm angles
- Bulls eye view vs progression view

Positioning

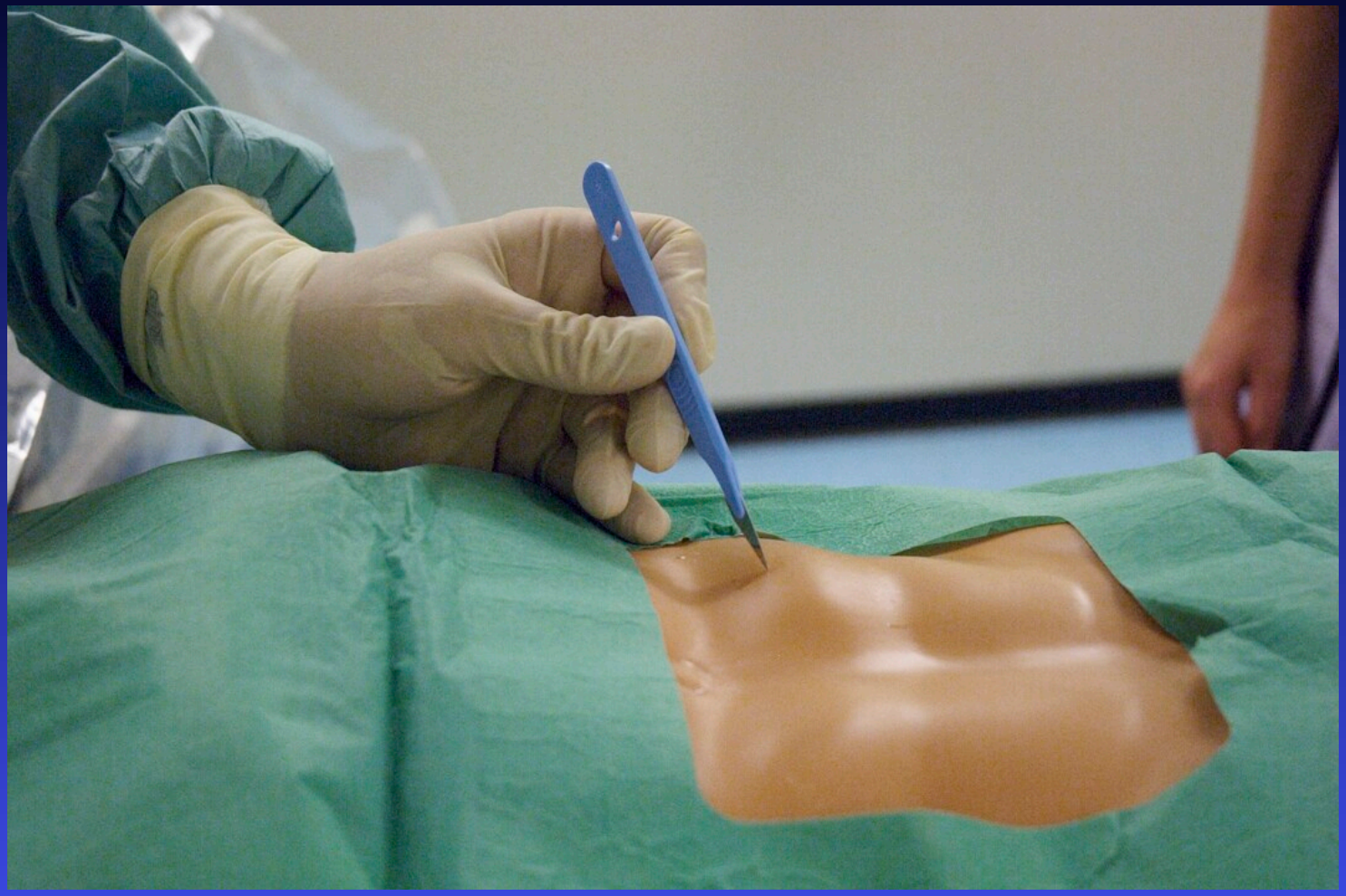
Positioning

- Determine incision point under fluoroscopy

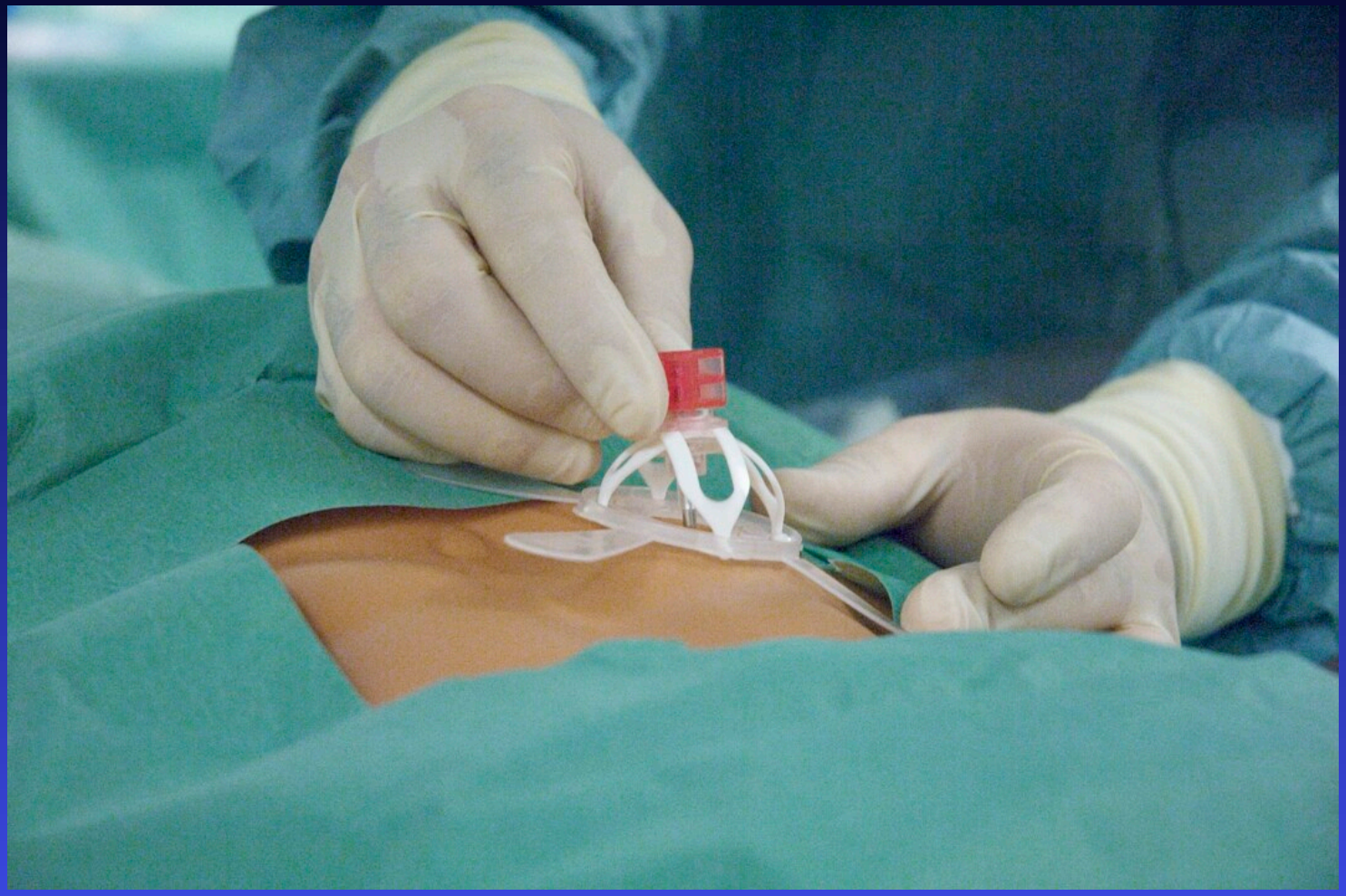
Positioning



Positioning



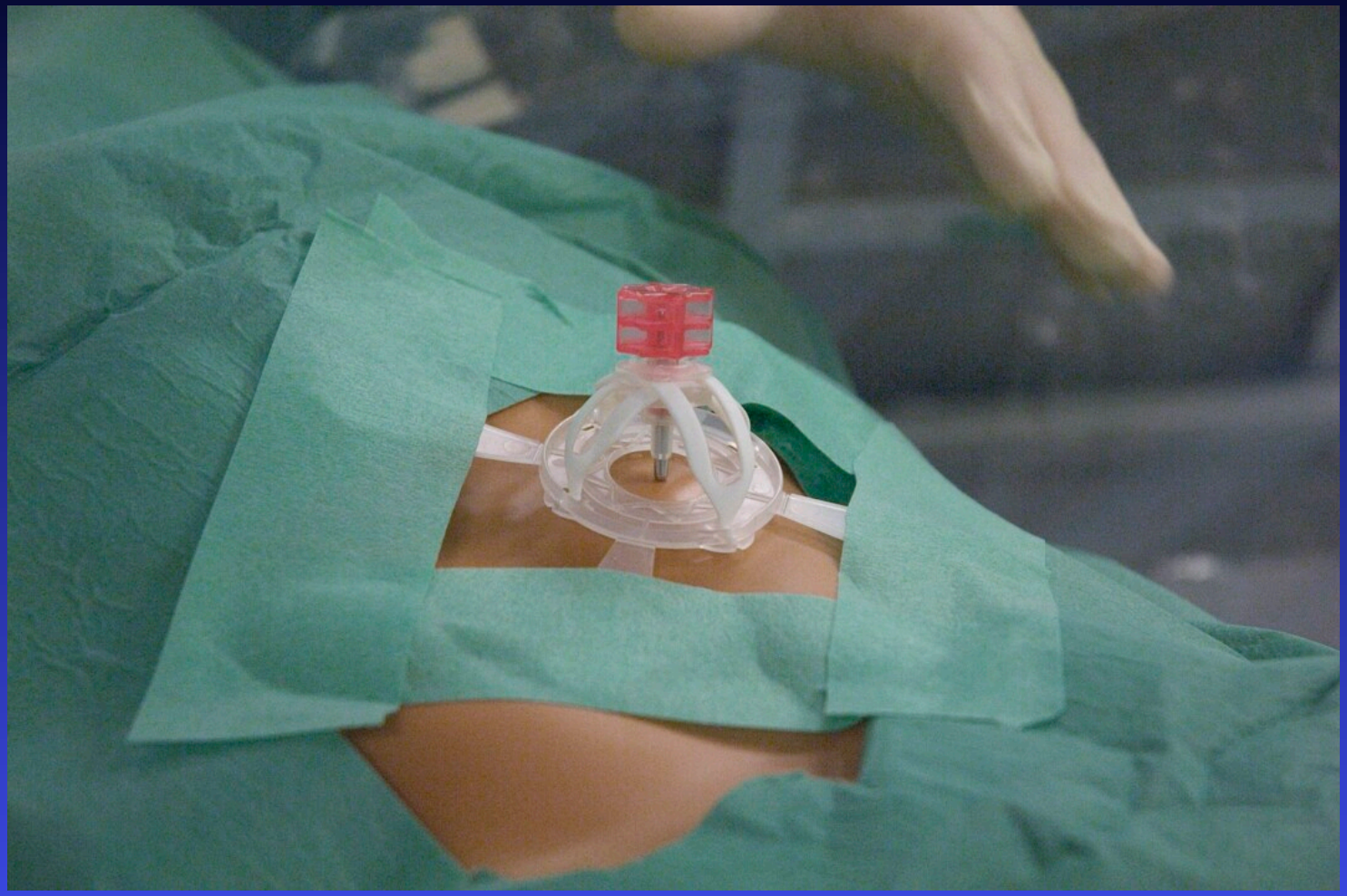
Positioning



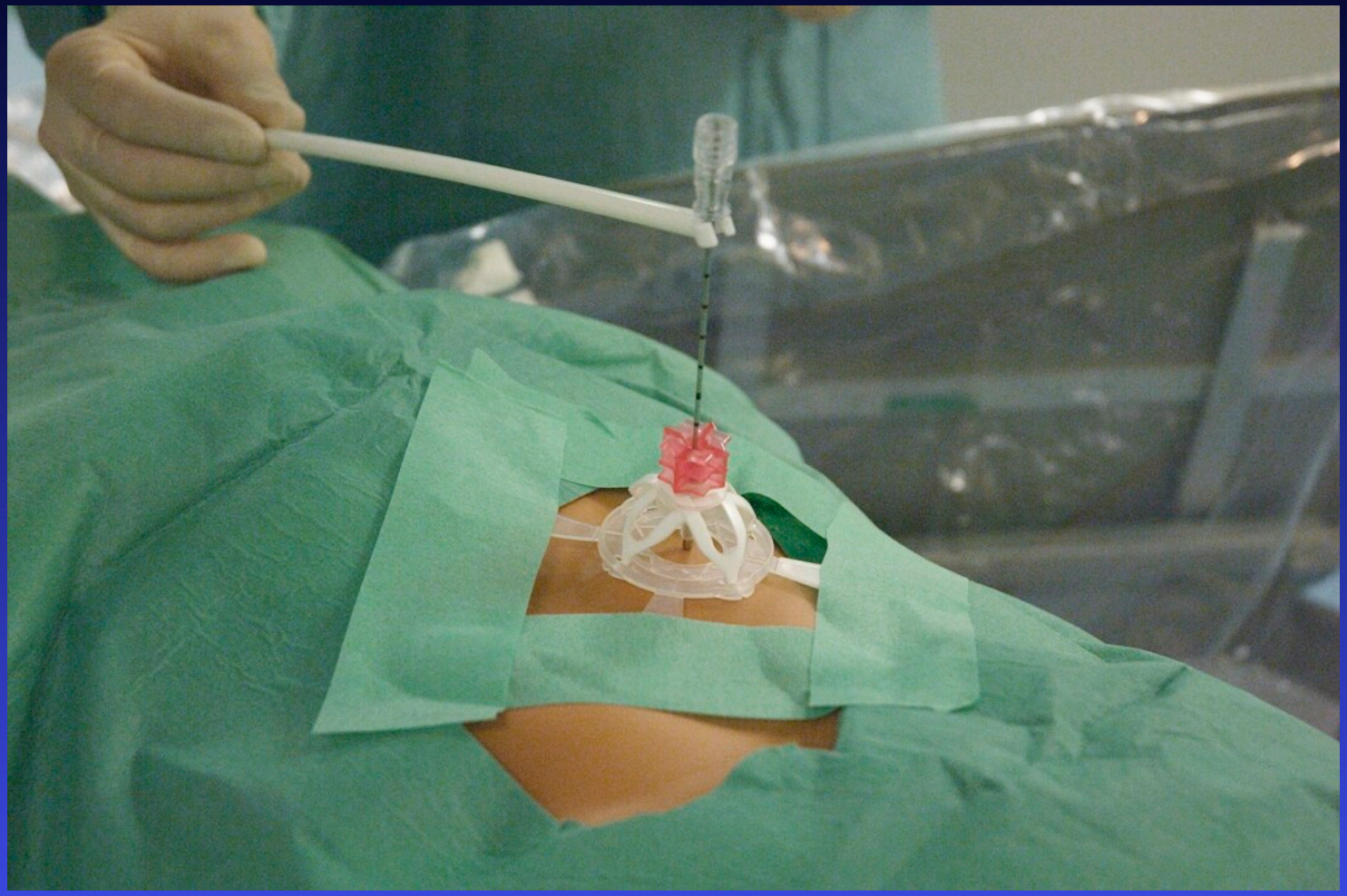
- Seestar positioning device (Apriomed)

Positioning

Positioning

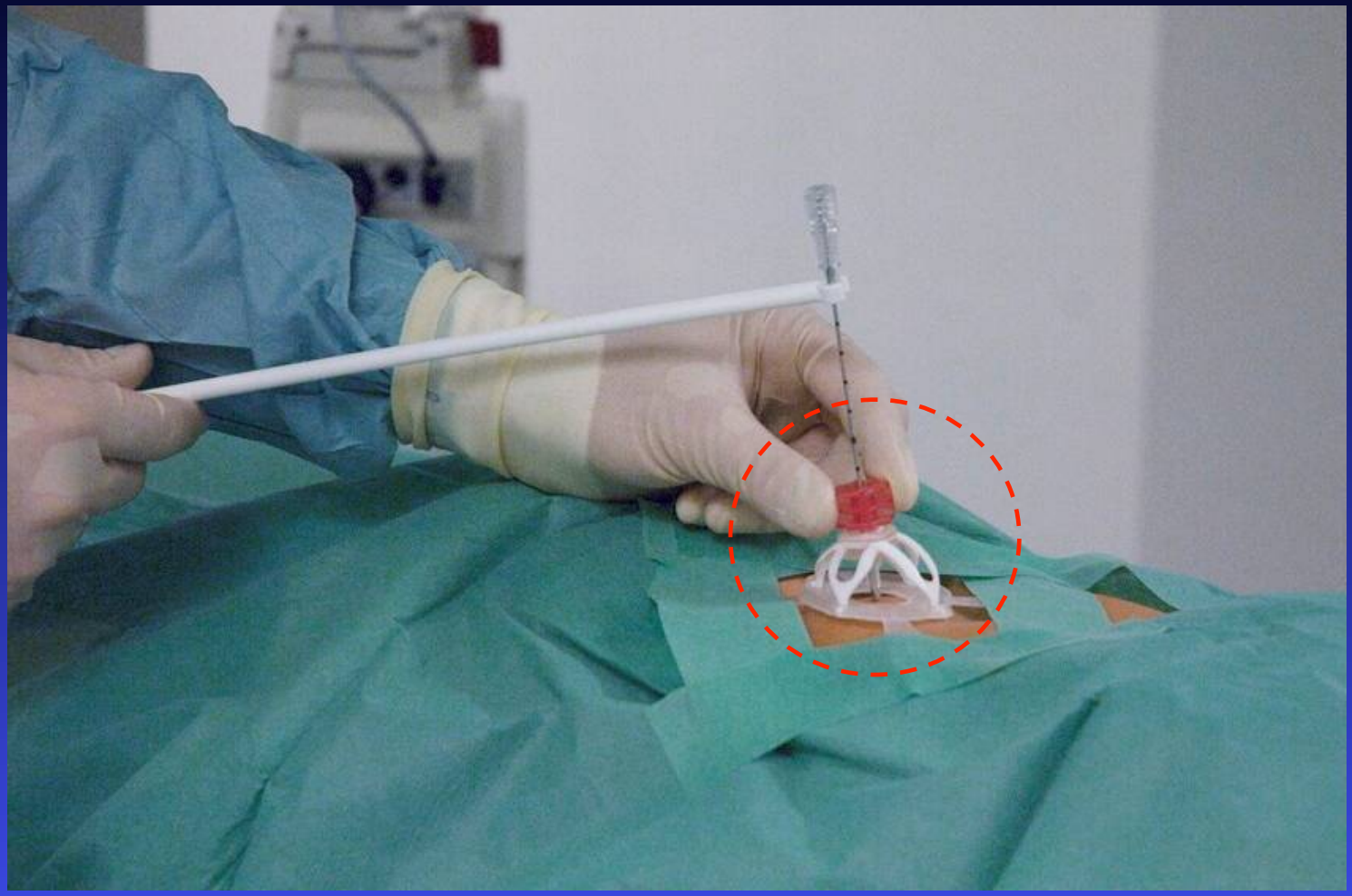


Positioning

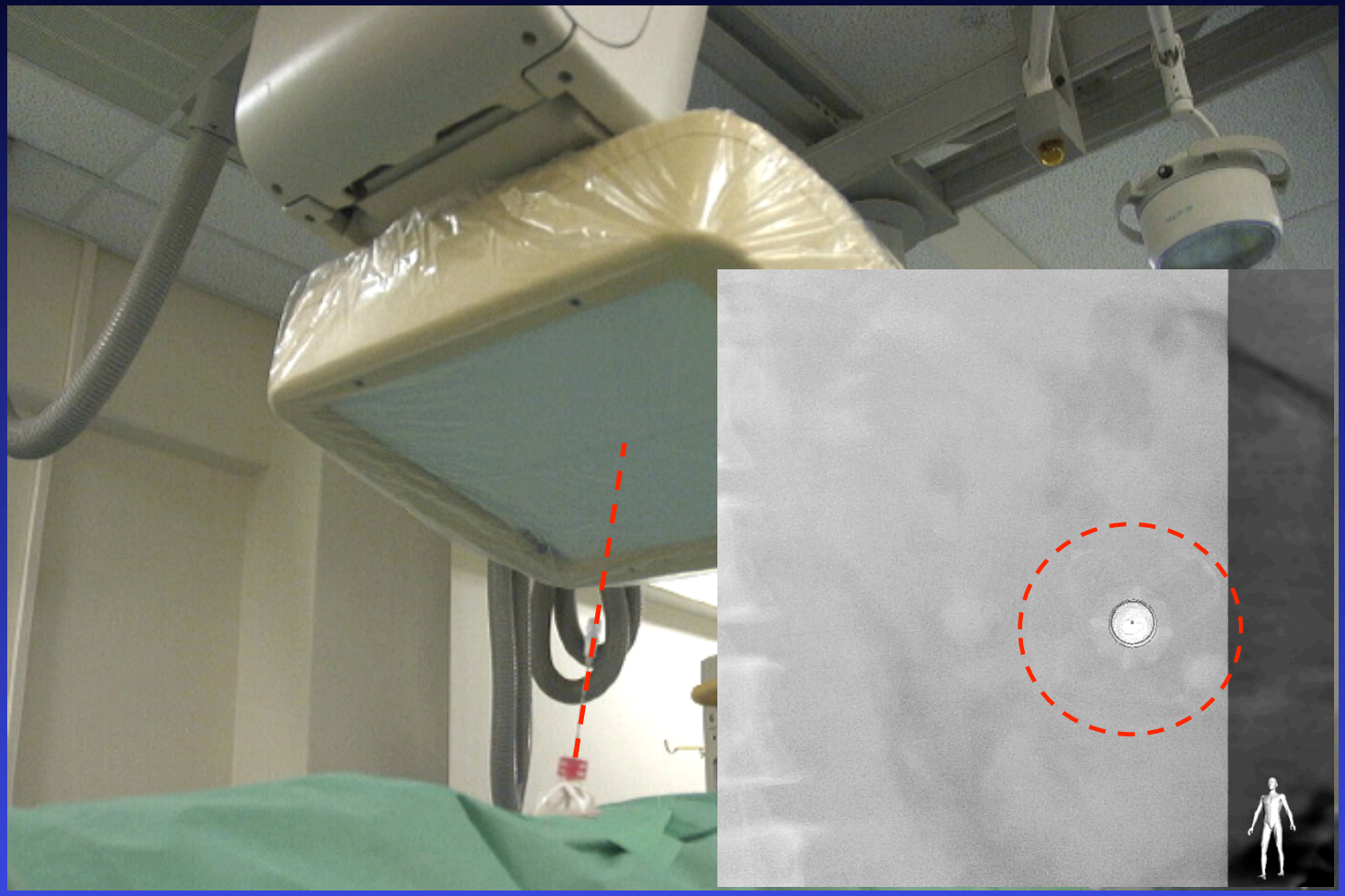


Positioning

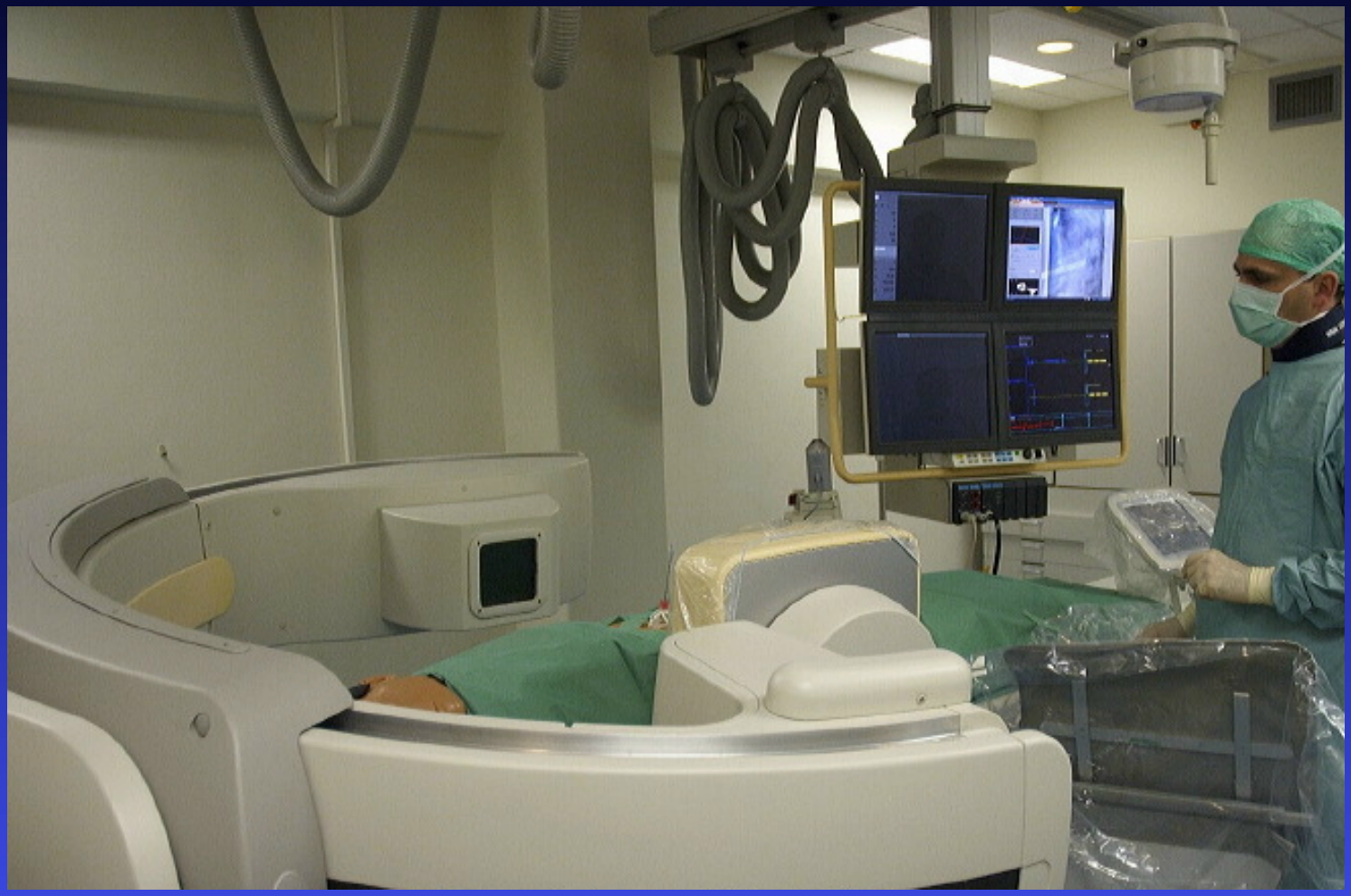
Positioning



Positioning



Positioning

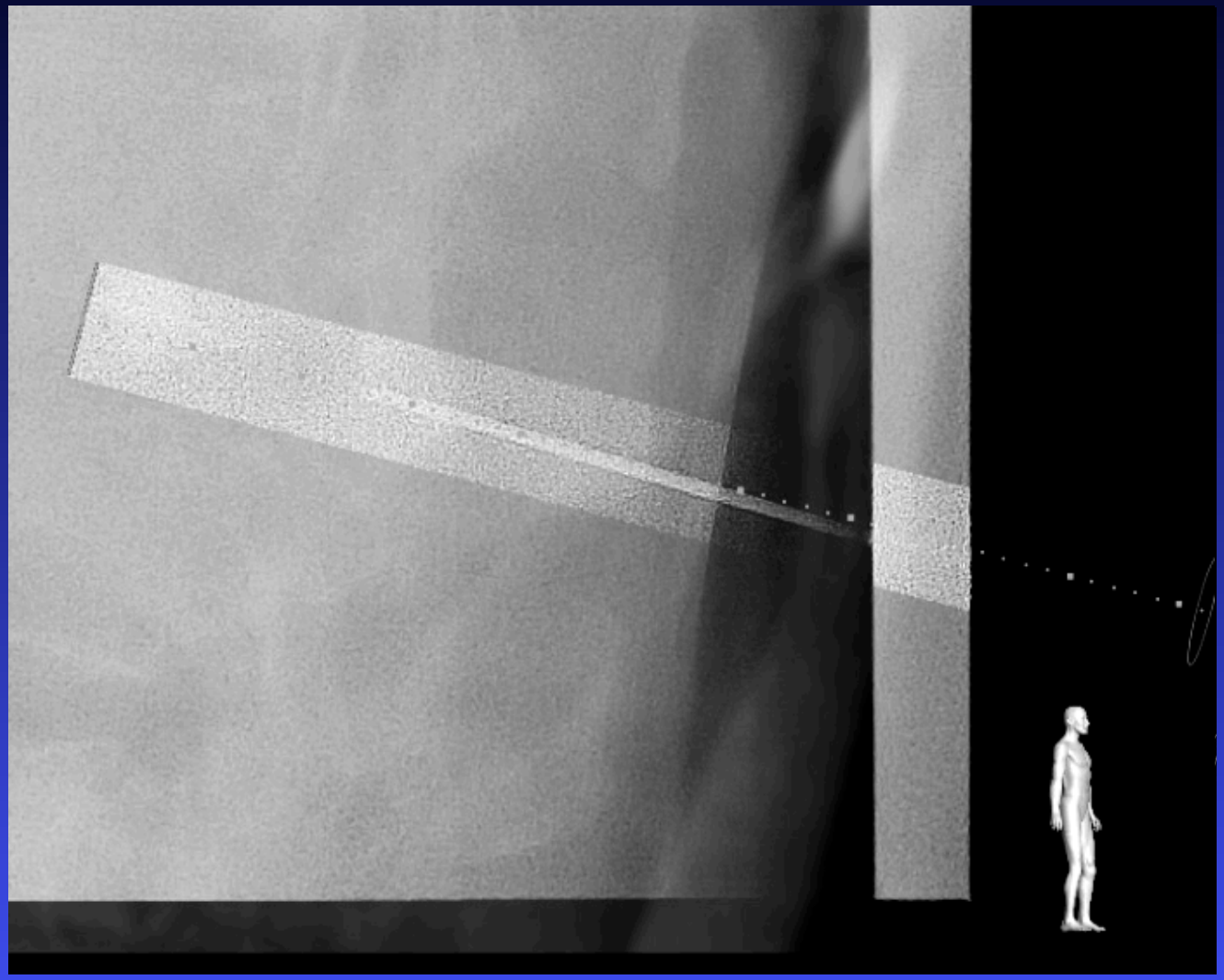


- C-arm perpendicular to needle (progress view)

Biopsy

- Advance needle under realtime fluoroscopy

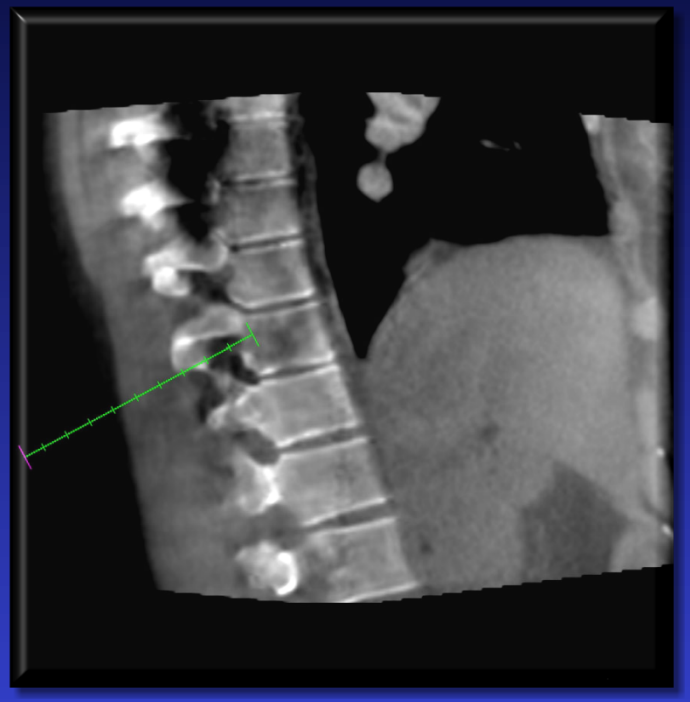
Biopsy



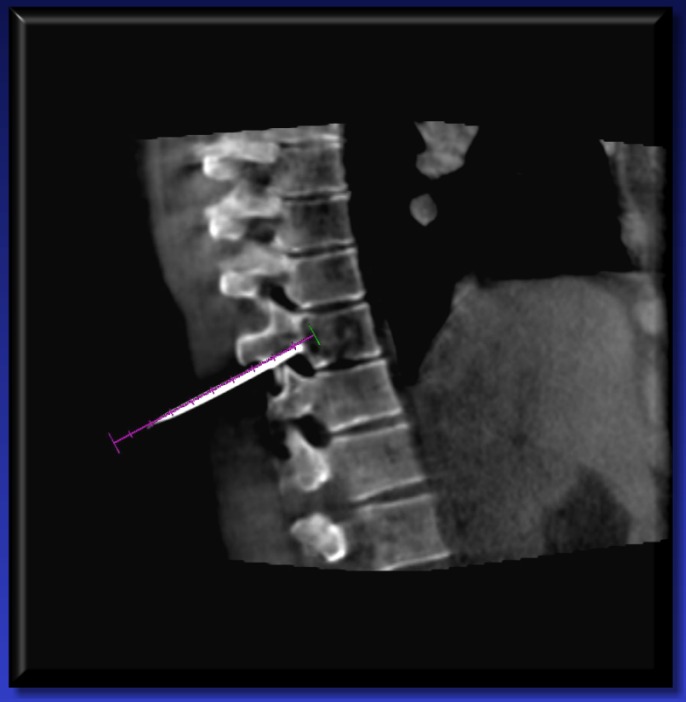
Biopsy

XperGuide

Verification with new XperCT scan



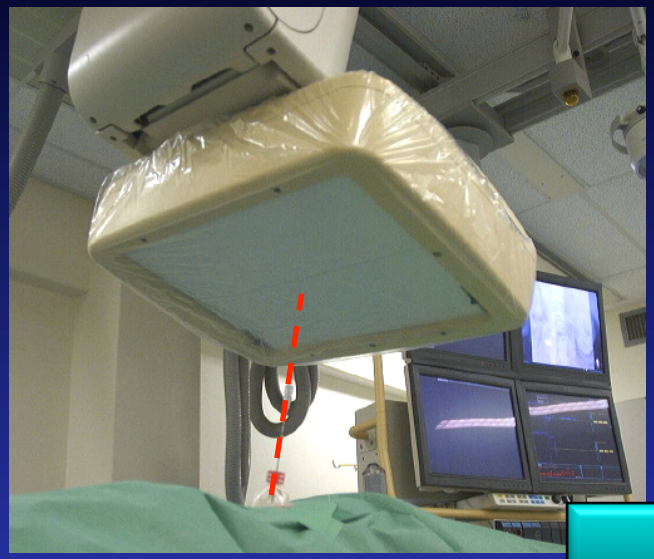
Planned path

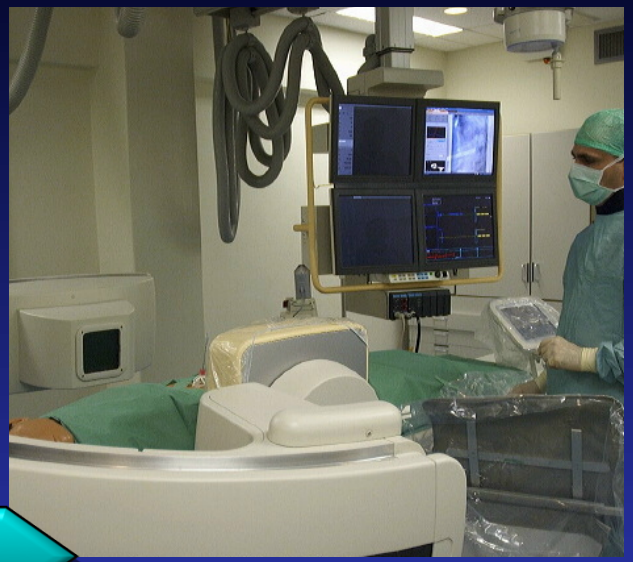


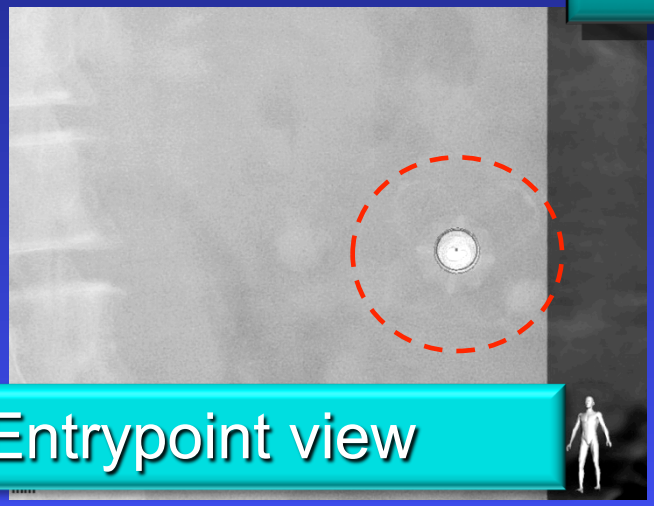
Verification

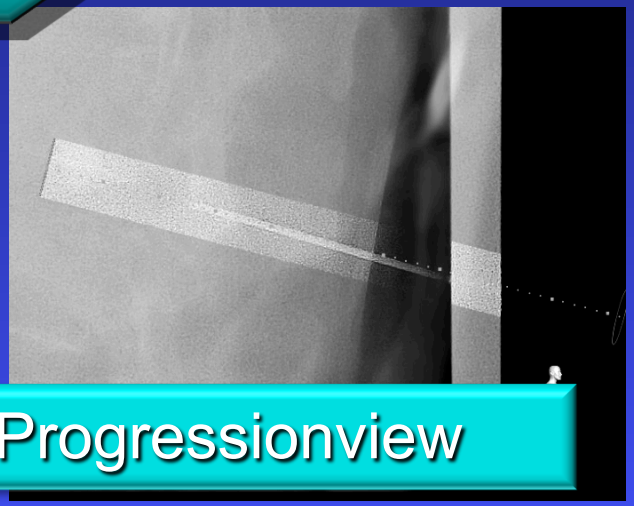
- Confirming needle position
- Check for complications

Targeting



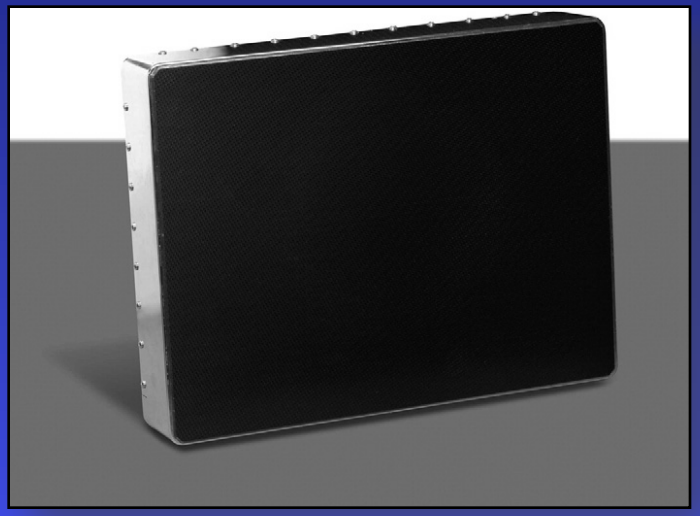






Limitations of CBCT vs MDCT

- Field of view
- Slow rotation (lag time Cs:I detector)
- Susceptibility for movement
- Lower SNR due to scatter
- Less HU resolution



Dose considerations

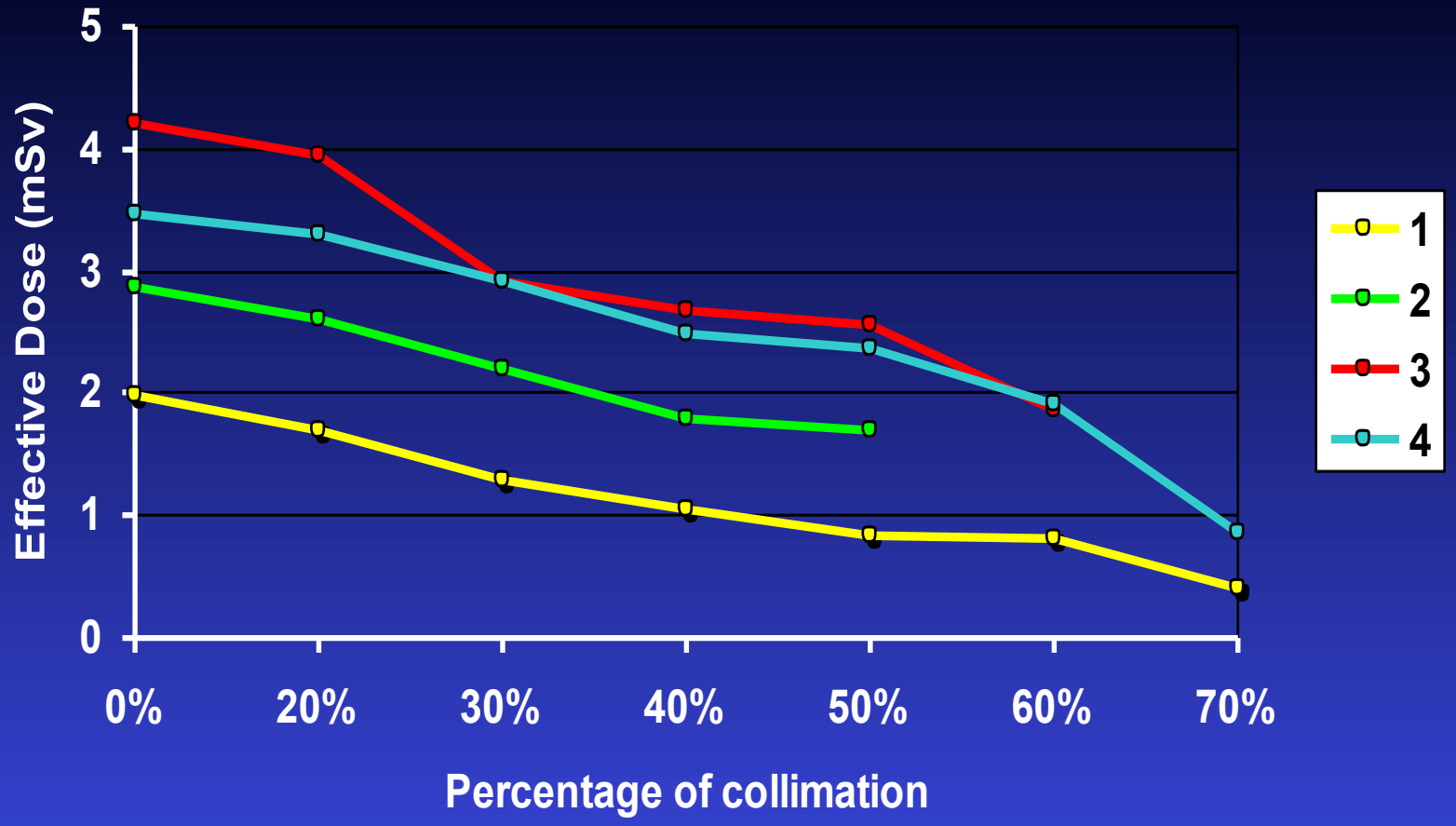
Effective dose comparison

Category	CBCT-guidance TOTAL (mSv)		CT-guidance TOTAL (mSv)
Upper Thorax	7.6	41.5%	13.0
Lower Thorax	12.8	15.2%	15.1
Upper Abdomen	16.1	21.1%	20.4
Lower Abdomen	13.3	13.6%	15.4

Braak SJ, van Strijen MJ et al. JVIR 2011 Apr;22(4):455-61

Collimation

Work in progress



Added benefit: better image quality due to lower scatter

Braak SJ, van Strijen MJ et al. submitted

Enhancing

Enhancing CBCT

- Reconstruction algorithms
  - Metal artefact reduction
  - Enlarged field of view (reduced IQ)
- Merging with available high res imaging
  - CT / MR / PET
- Additional IR information
  - Tumor position
  - Ablation effect
  - Feeding vessels

Metal artefact reduction

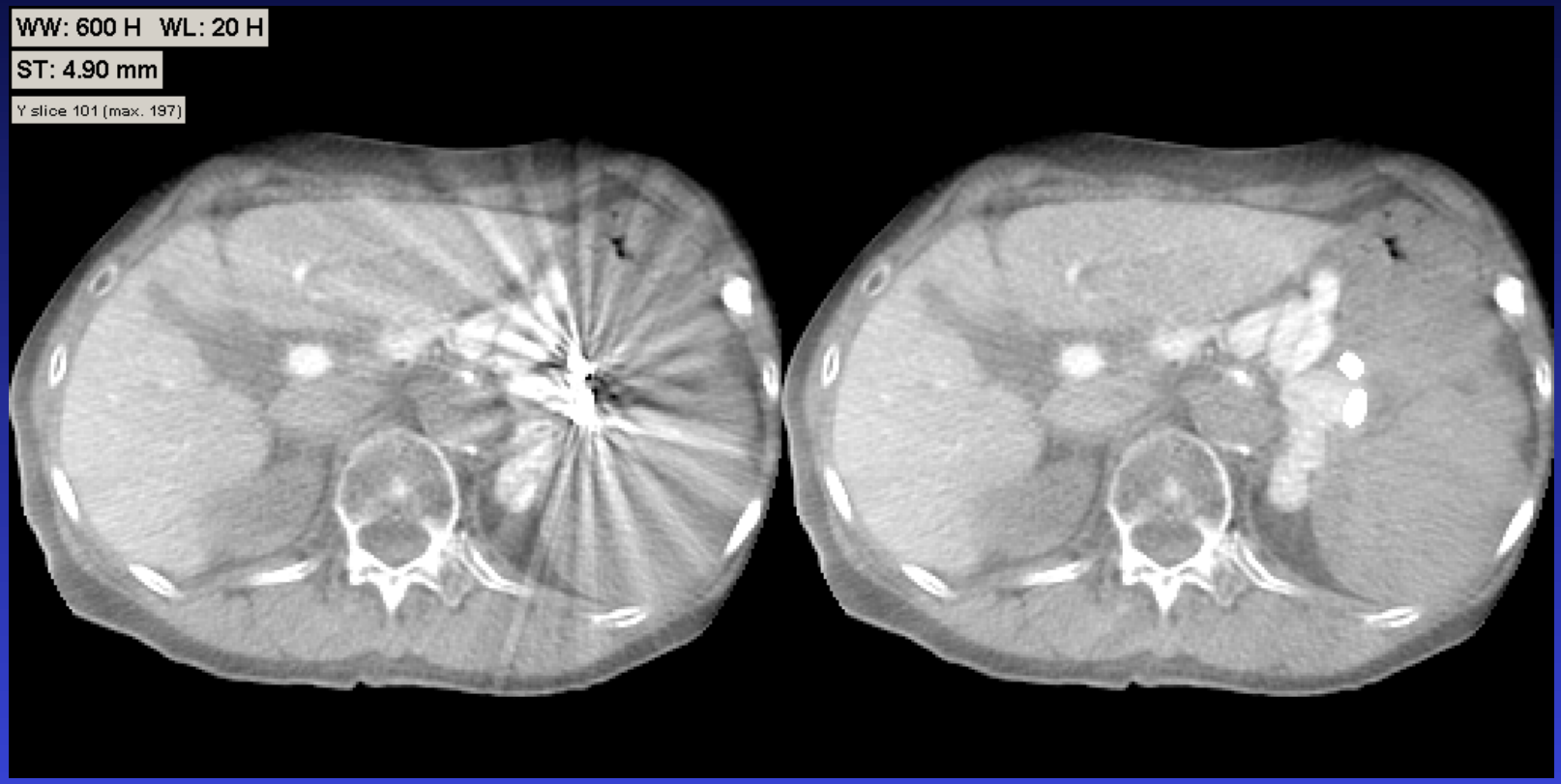
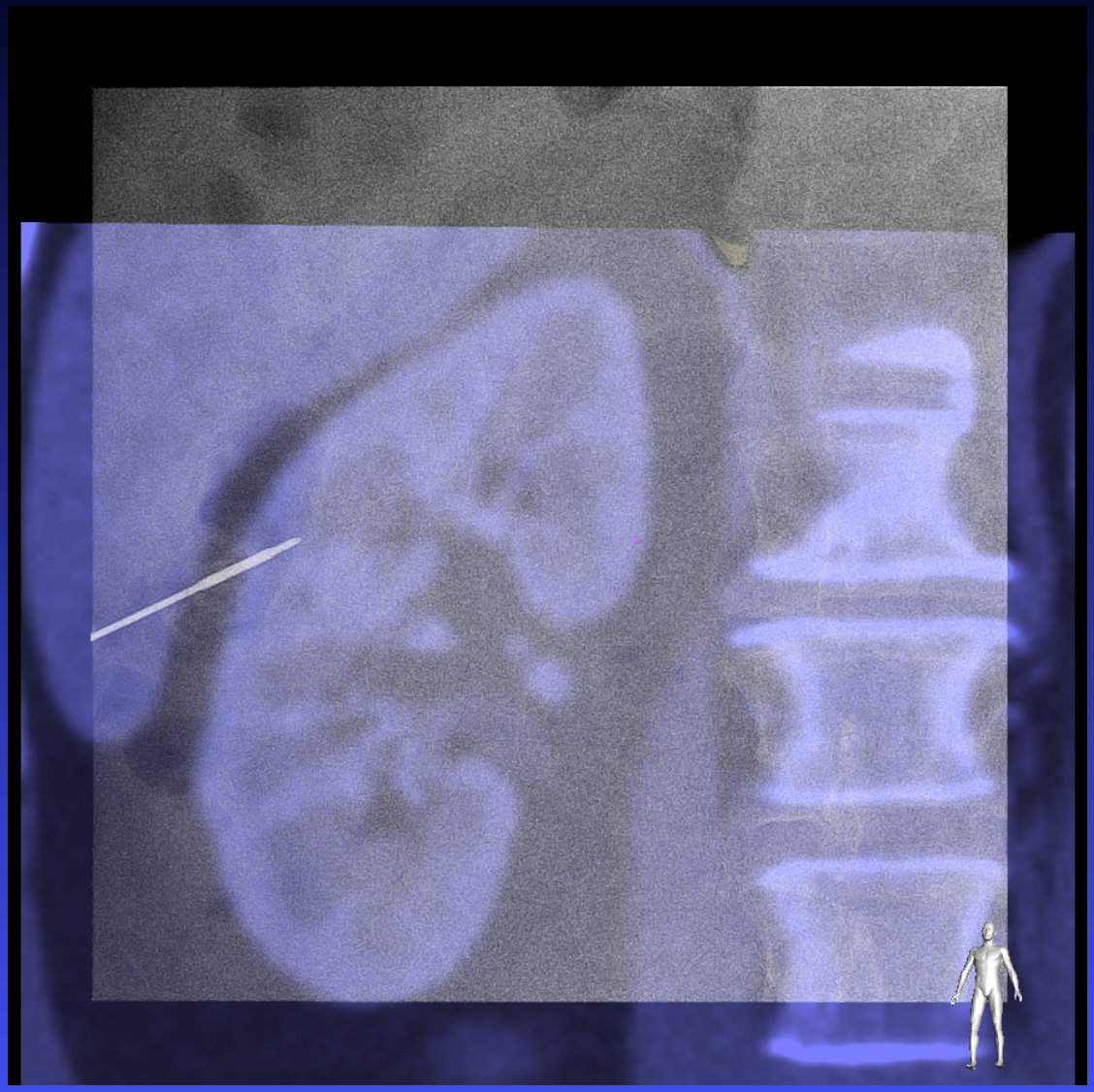
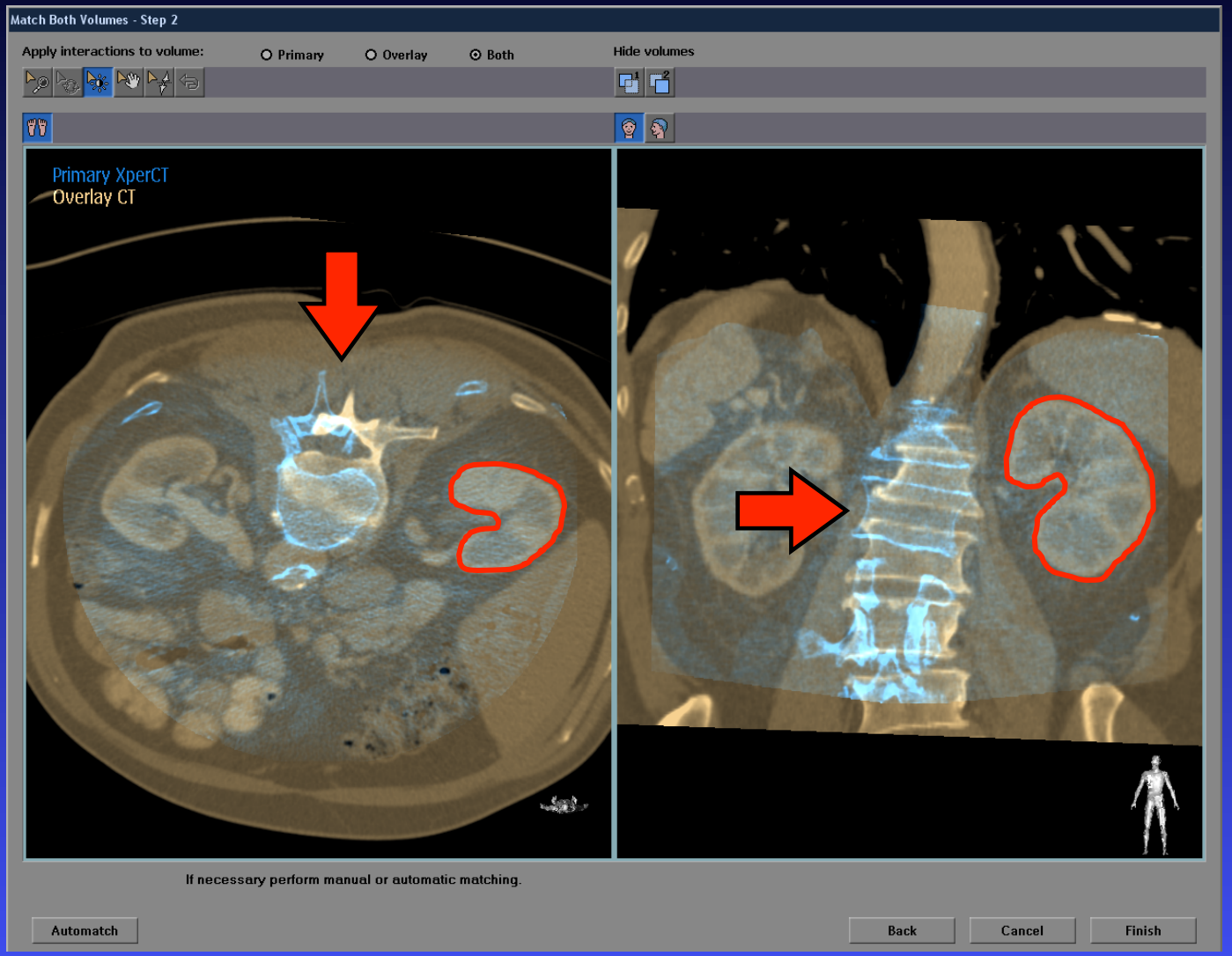


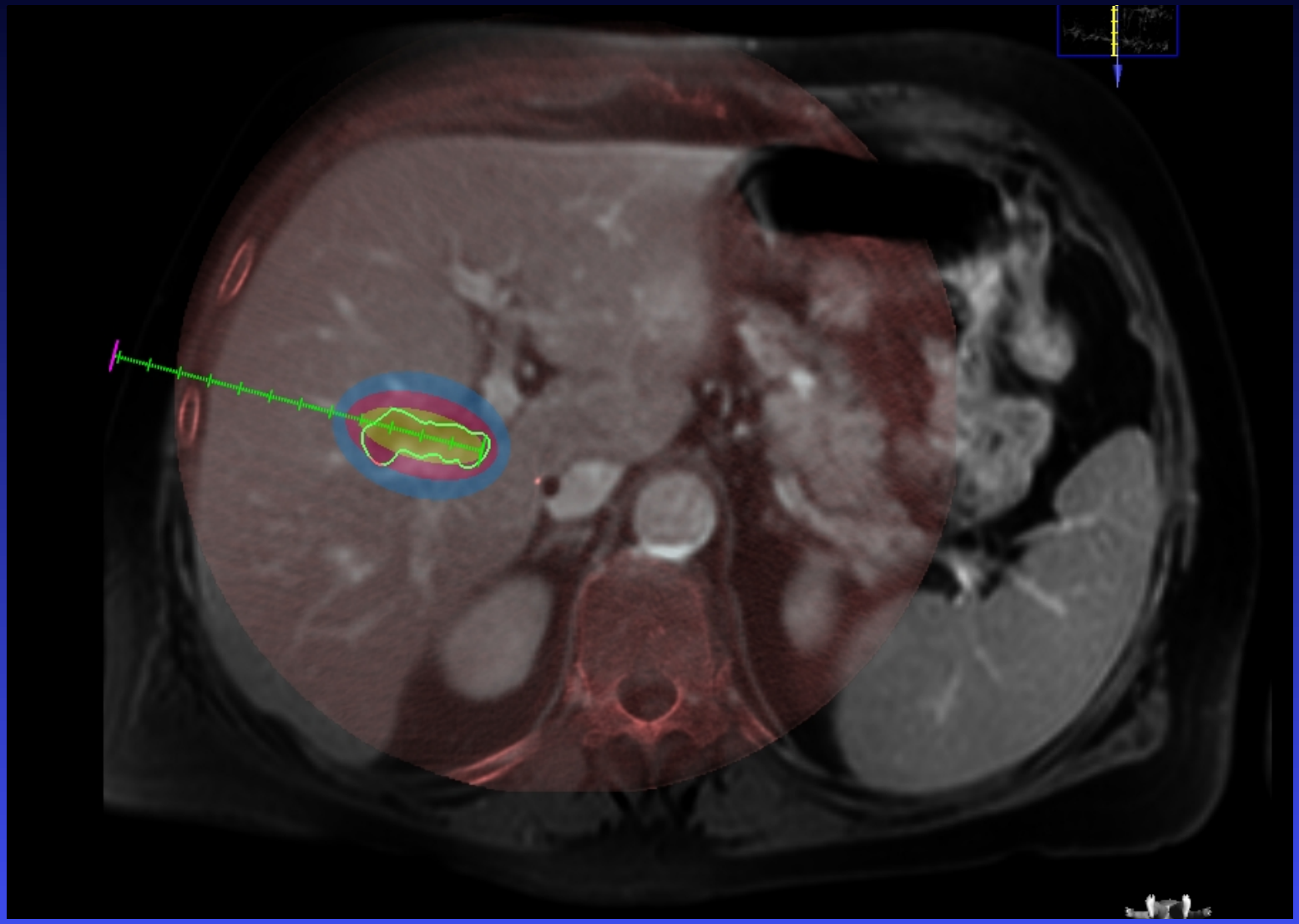
Image Courtesy: Dr Matsumaru , Toranomon hospital , Tokyo, Japan

XperCT and overlay

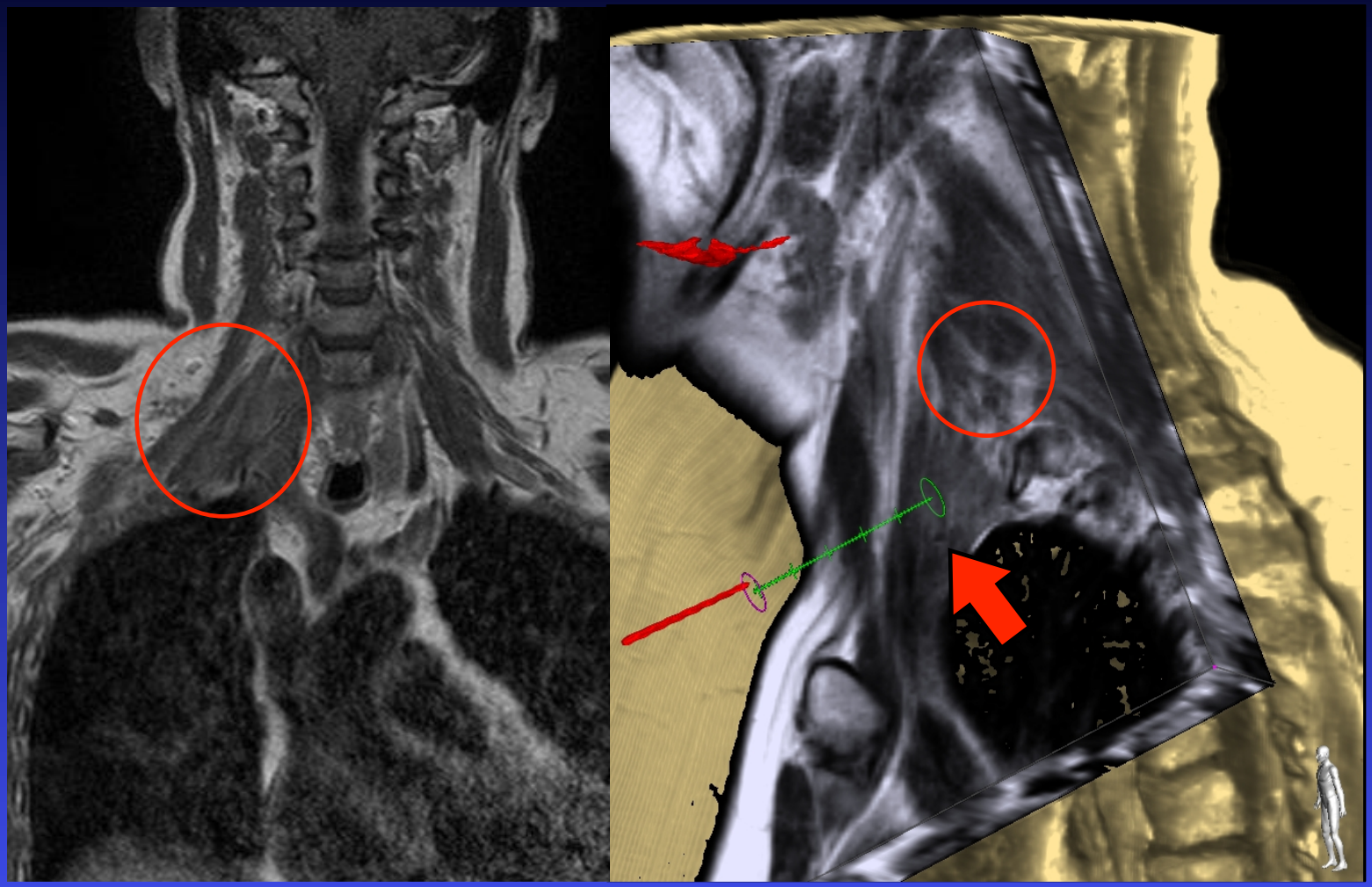



Match Both Volumes - Step 2
Apply interactions to volume:
Primary
Overlay
Both
Hide volumes
Primary XperCT
Overlay CT
If necessary perform manual or automatic matching.
Automatch
Back
Cancel
Finish

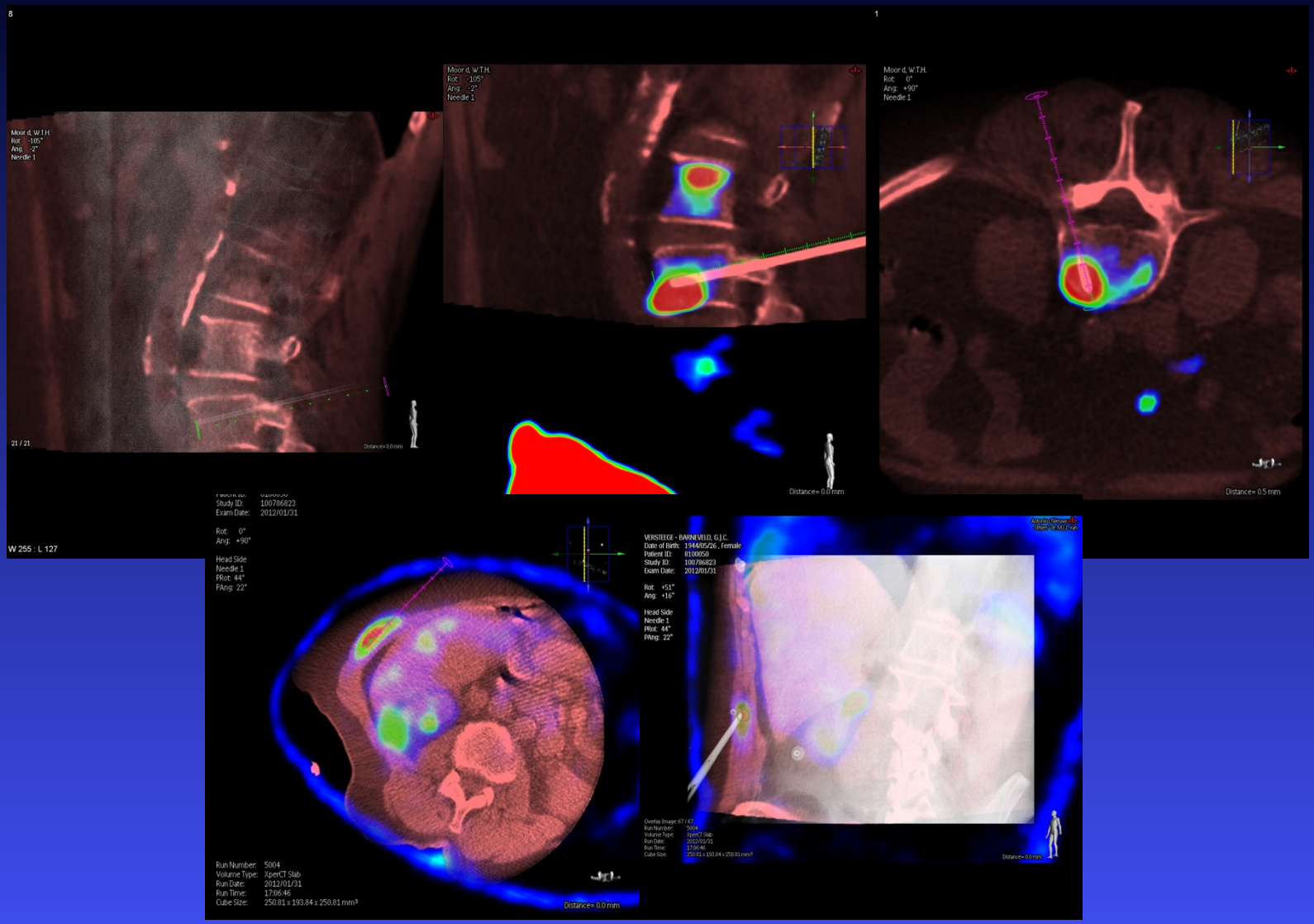
Merging with MRI



MR



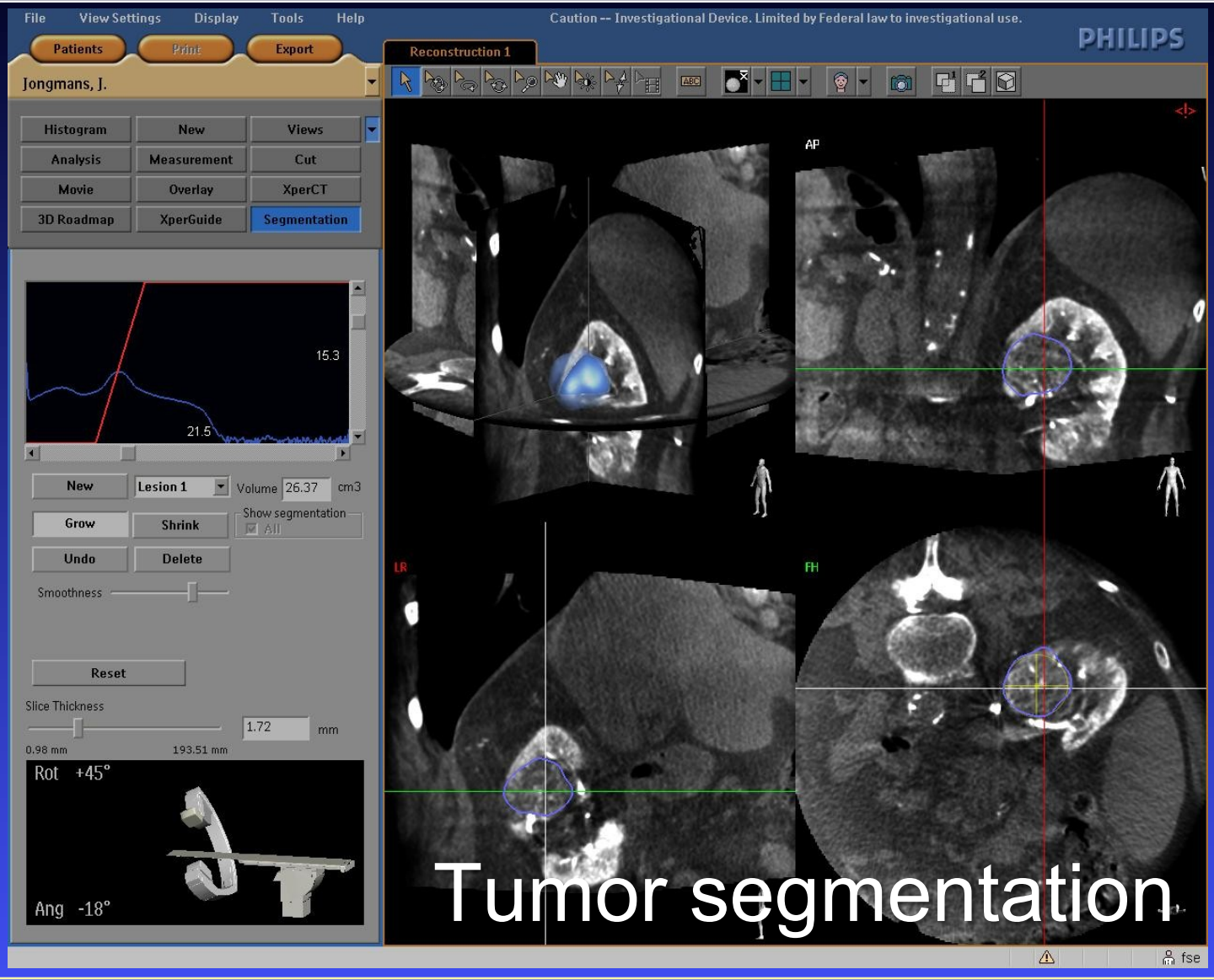
Merging with PET



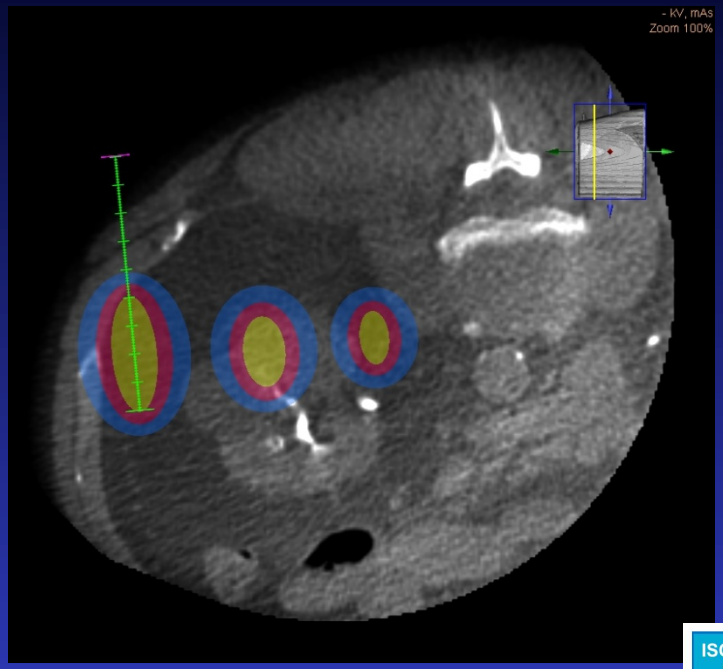
Work in progress

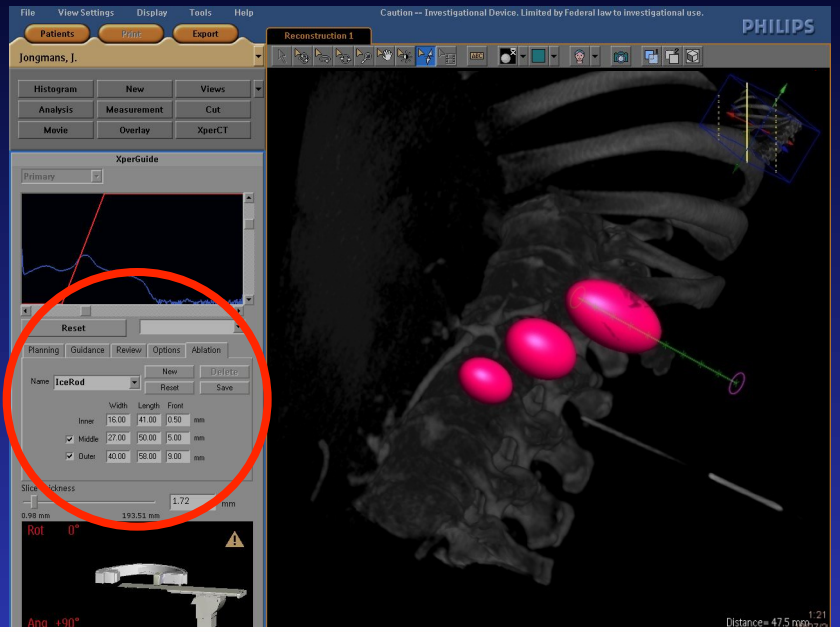
Tumor segmentation

Work in progress

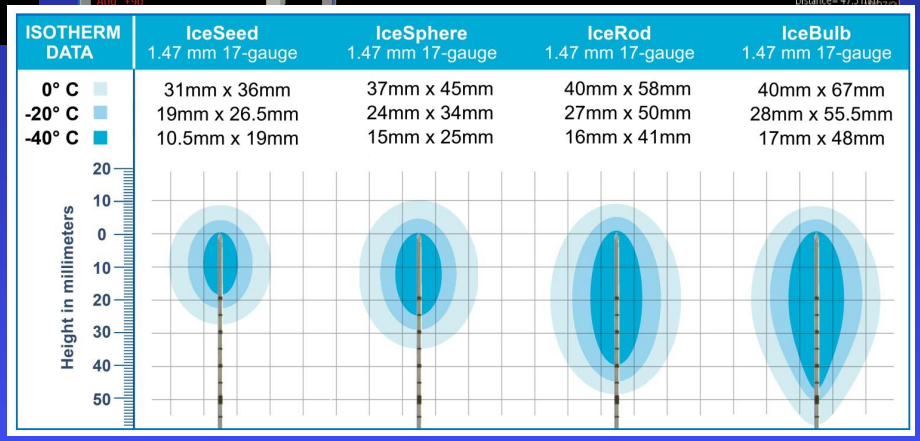


Ablation planning



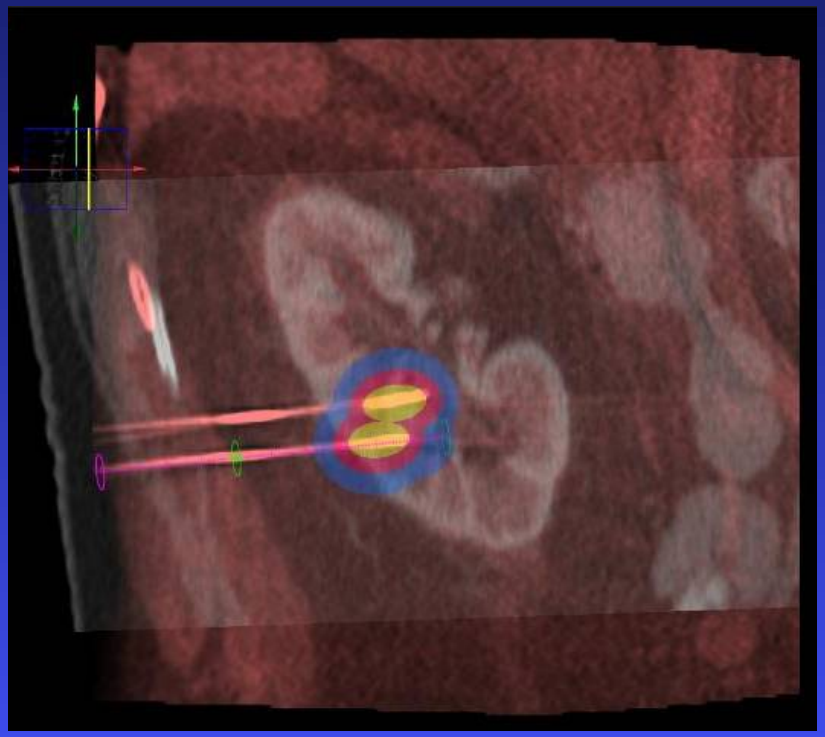


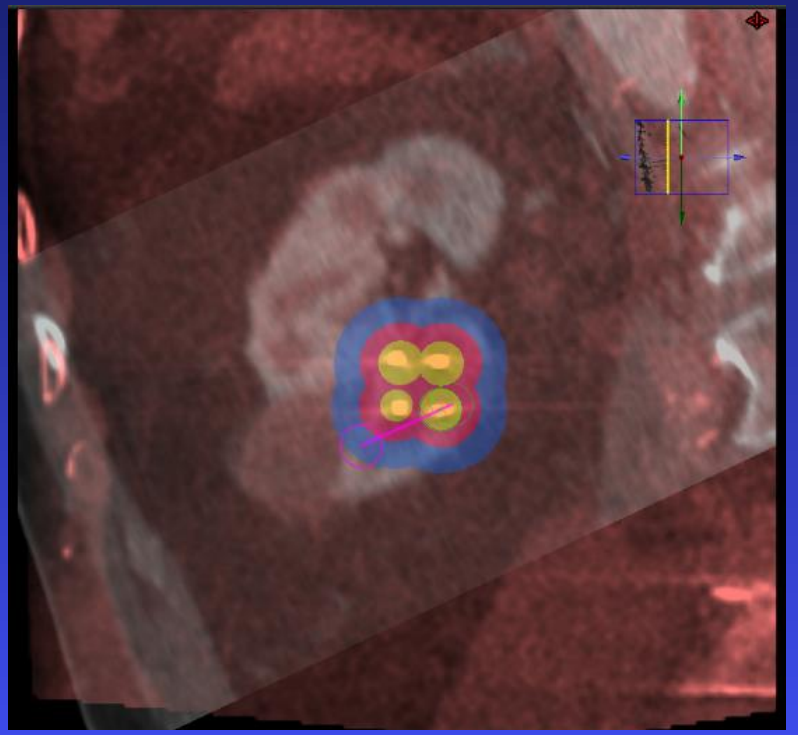
Same principle for RFA or MWA



Combining

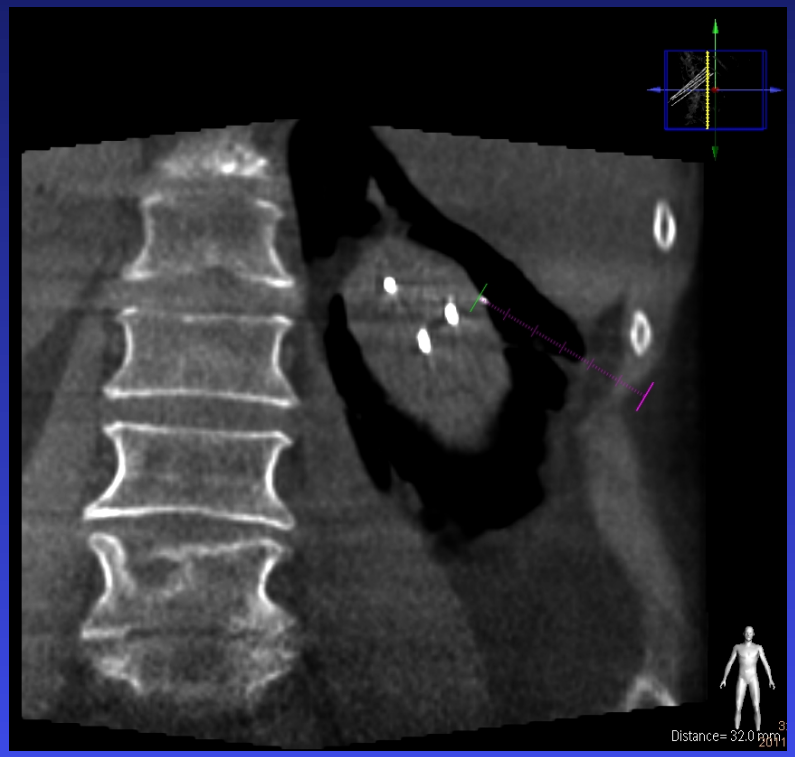
- XperCT, conventional CT overlay and ablation planner combined

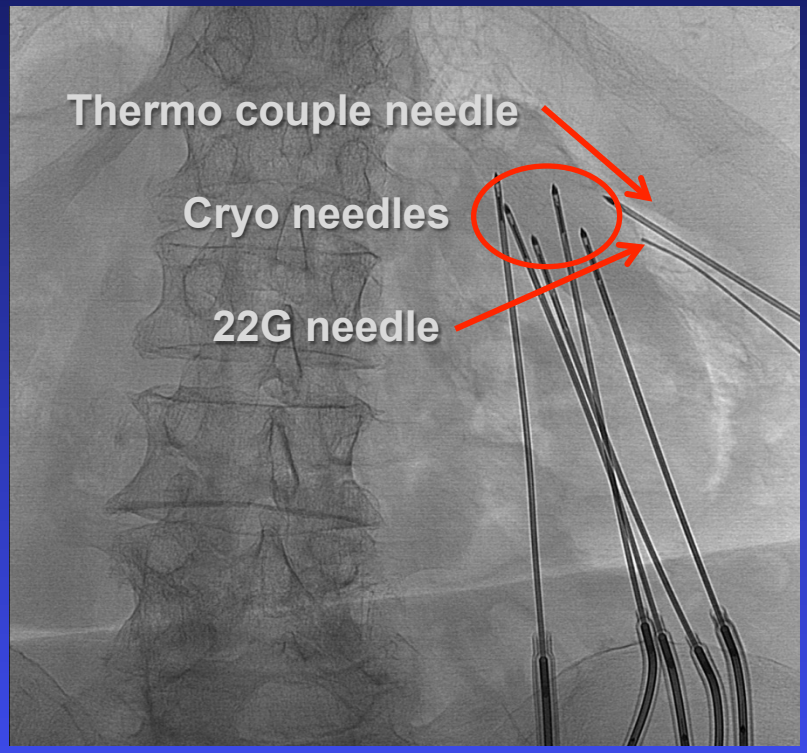




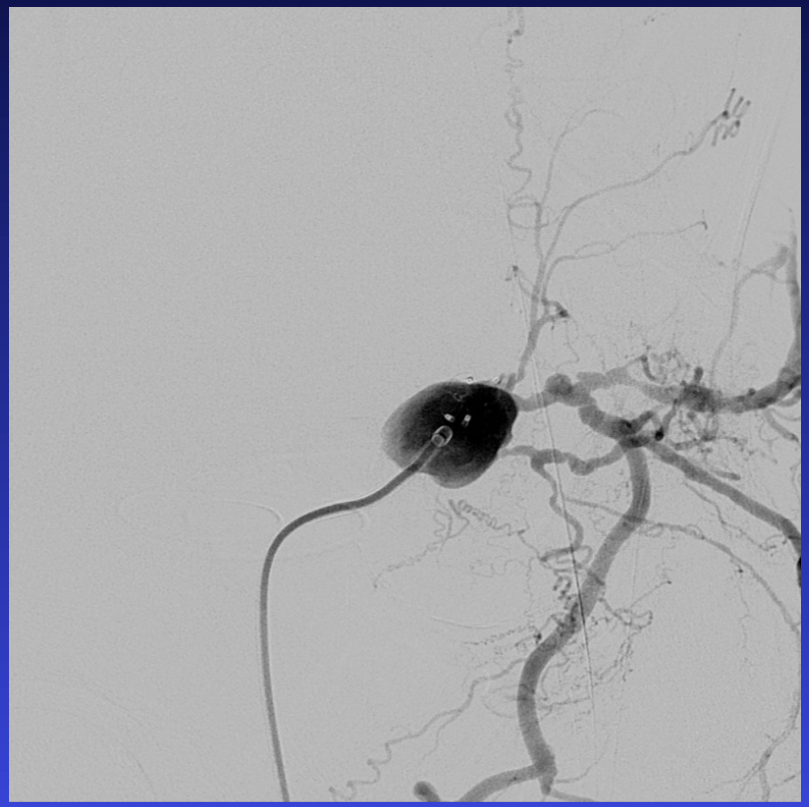
Hybrid imaging

- Cryo ablation overview
- CO_2 dissection





Hybrid imaging



Clinical application biopsy

Results Renal biopsies

43 lesions

Malignant (N=24):
11 Heldercellig NCC
1 Eosinofiel type NCC
1 Neuro endocriene tumor
2 Papillair NCC
1 Chromofoob NCC
1 Sarcomatoid type NCC
4 Urotheelcelcarcinoma
2 Metastase van NSCLC
1 B-

56%

Benign (N=14):
2 Normaal nierweefsel
3 Post infectieus
1 Organiserend hematoom
1 Angiomyolipoom
1 Inflammatoir pseudotumor
3 Oncocytoom
1 Infarct

32%

Non diagnostic (N=5)
(3 no malignant cells)

12%

Follow up (N=3)
mean 13 mnth no growth

Clear cell (N=2)
in (partial) nefrectomy

Sensitivity : 24/26 = 92,3%

Braak SJ, van Strijen MJL. Eur Radiol. 2012 Nov;22(11):2547-52.

Results pulmonary biopsies

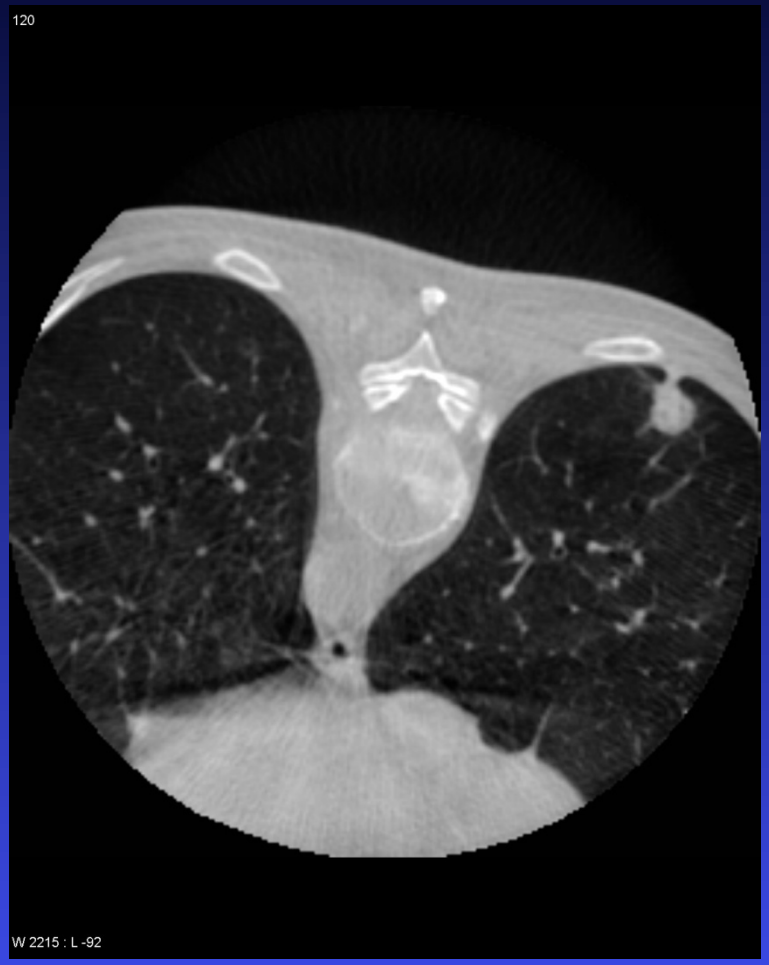
84 patients (2007-2010):

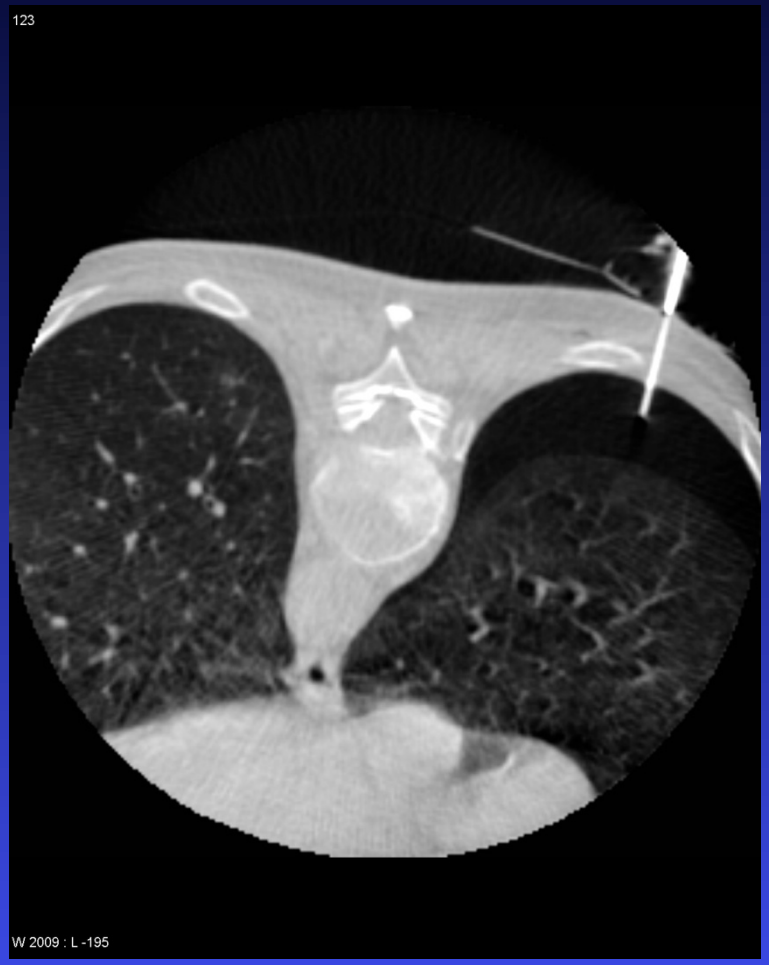
- Mean lesion diameter 32.5mm (3.0-93.0)
- Mean fluoroscopy time 161s (104-551)
- Mean room time 34mins (15-79)
- Intervention time 18mins (5-65)
- Non-diagnostic 7 (.3%)
- (atypical 1, necrotic 2, non-repr 4)

- Accuracy 91.7%

Braak SJ, van Strijen MJL. CVIR 2012 Dec;35(6):1414-21.

Complication management





Results pulmonary biopsies

84 patients (2007-2010):

16 minor complication (19%)

- 8 small pneumothorax
- 5 moderate pneumothorax
- 1 brief period of hemoptysis
- 2 patients additional 1 day stay for monitoring

2 major complication (2.4%)

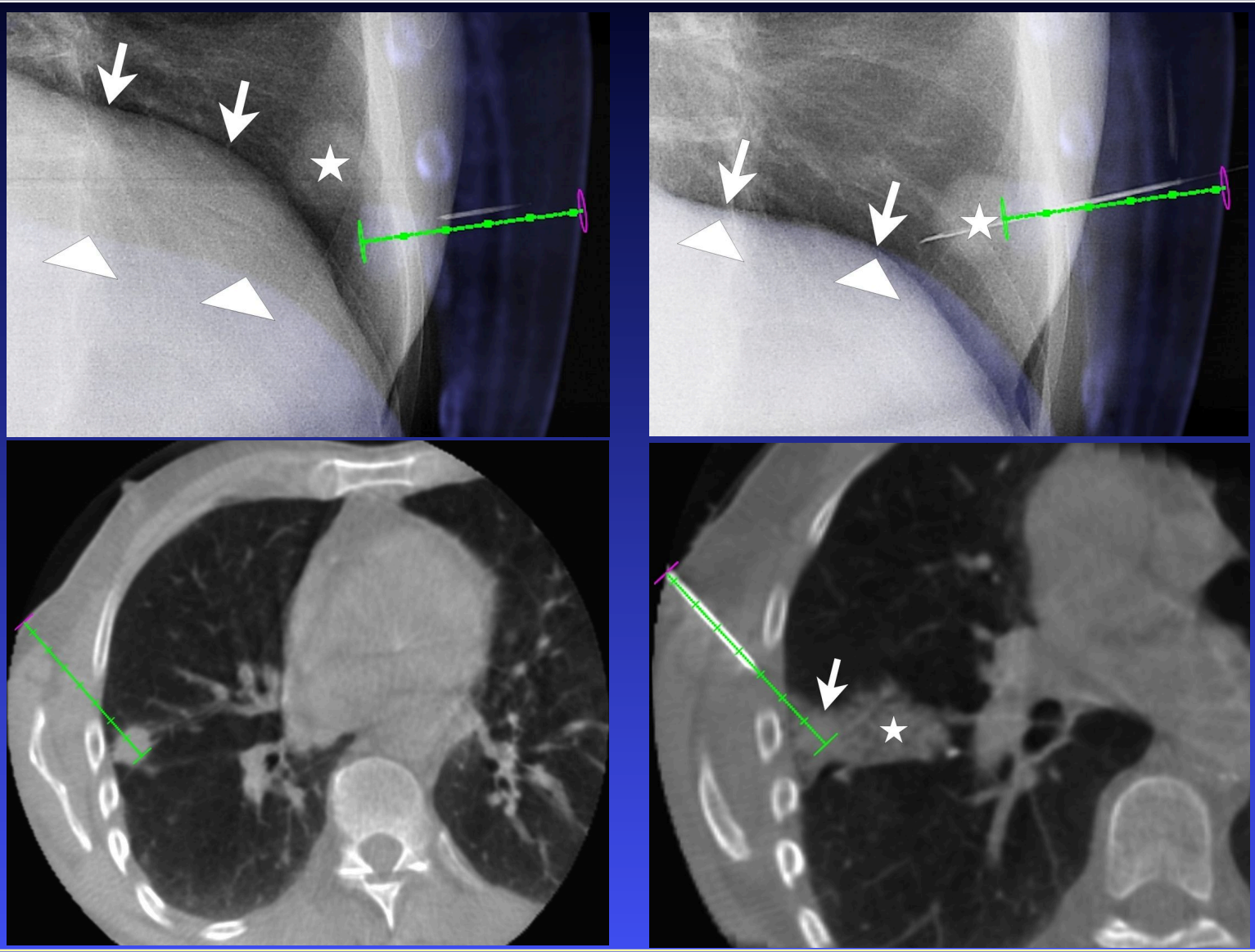
- 1 large pneumothorax requiring chest tube
- 1 moderate pneumothorax requiring additional hospitalisation

Higher complication rate in:

- lesions <30mm (30% vs 11%)
- parenchymal lesions (35.7% vs 7.1%)

Braak SJ, van Strijen MJL. CVIR 2012 Dec;35(6):1414-21.

Clinical example

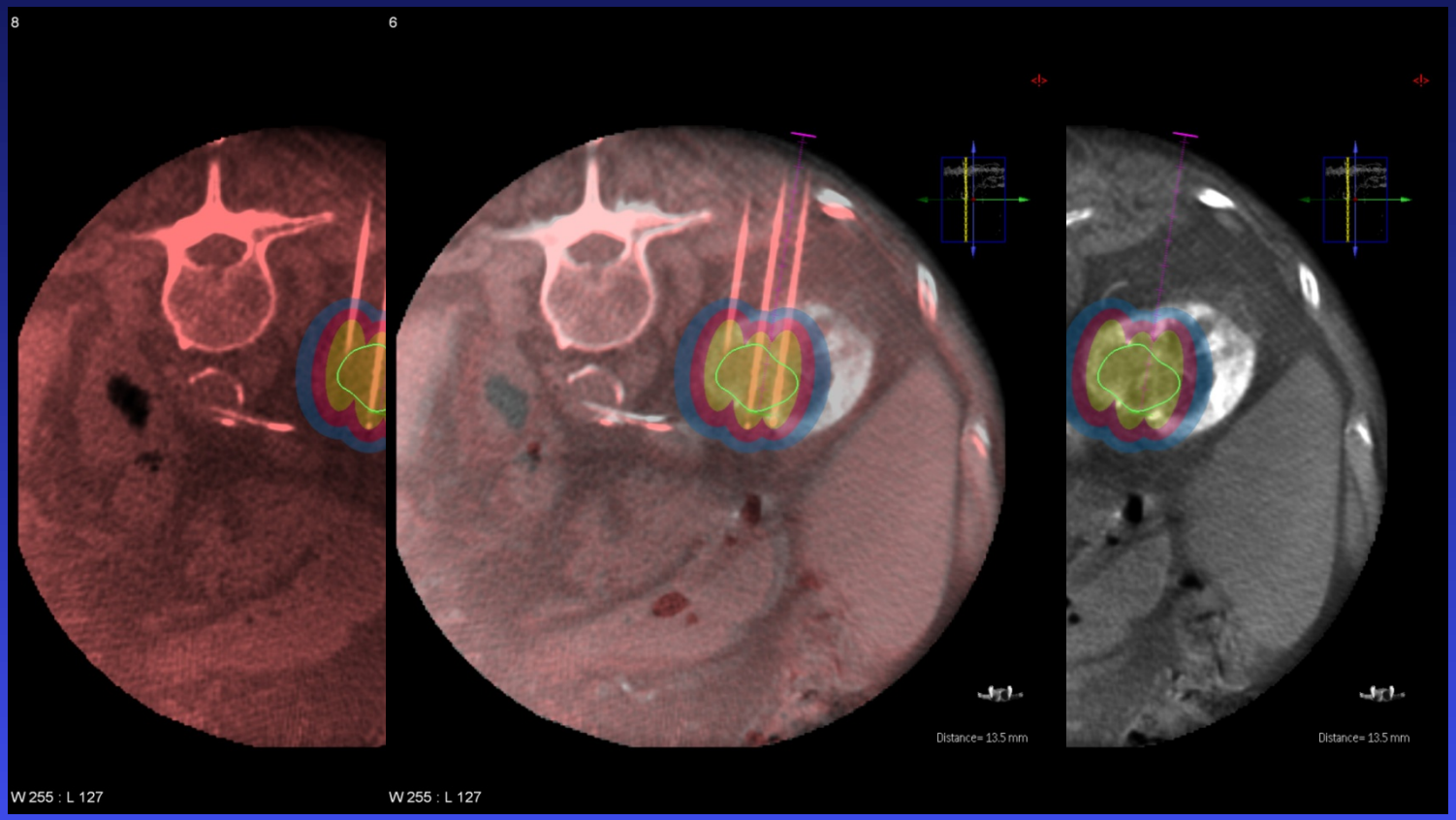


Braak SJ, van Strijen MJL. CVIR 2012 Dec;35(6):1414-21.

Clinical apllication
Percutaneous ablations

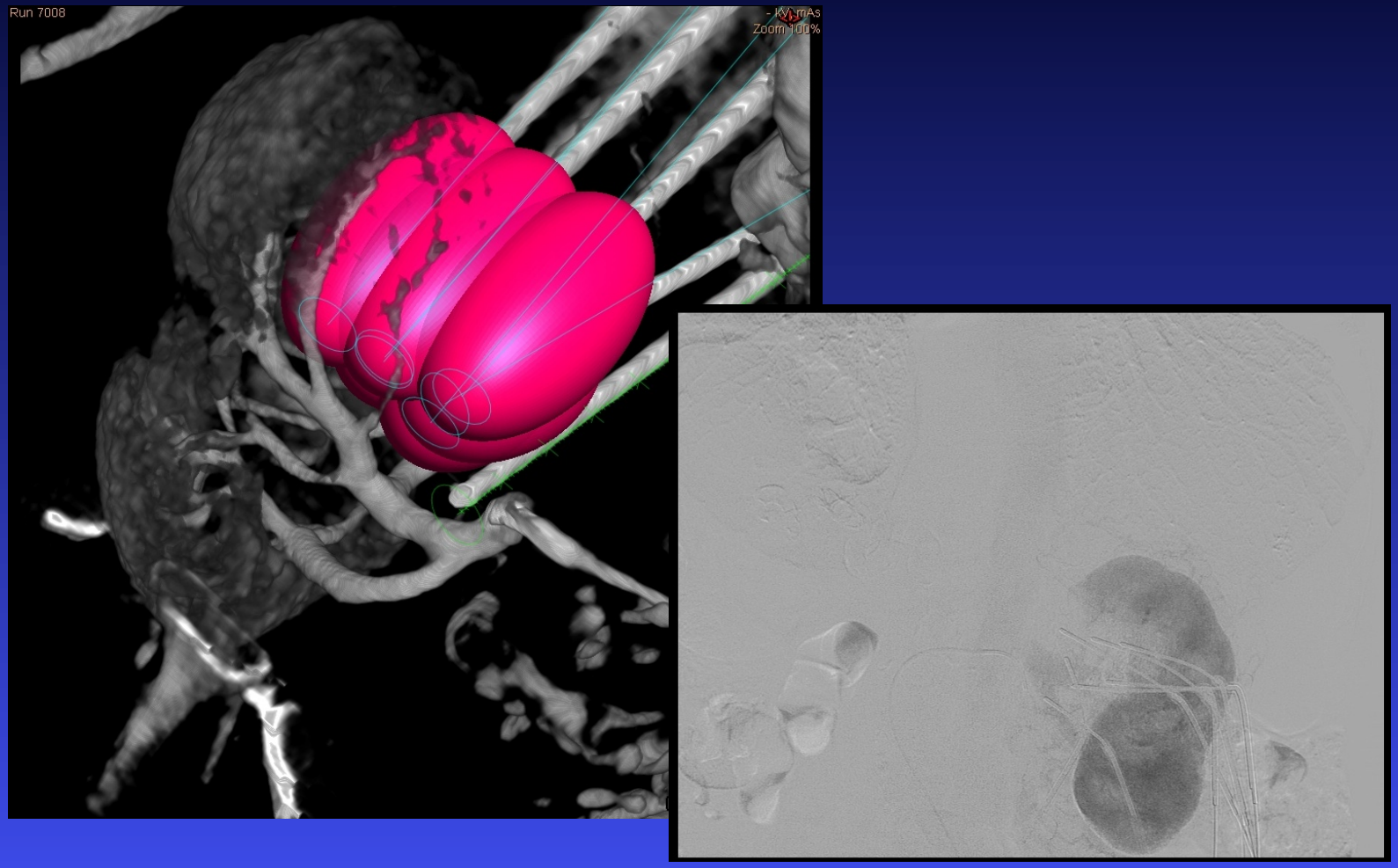
Monitoring

Merging with previous acquisition



Monitoring

Monitoring

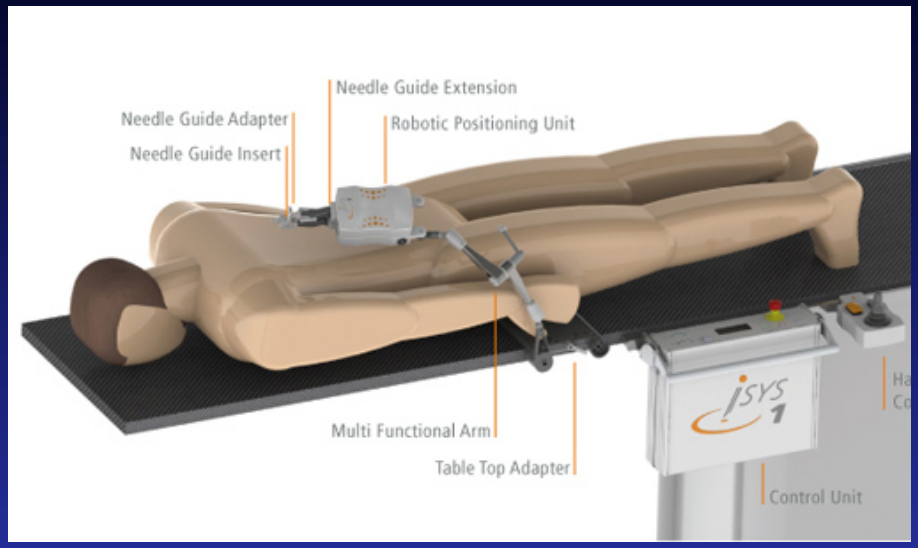


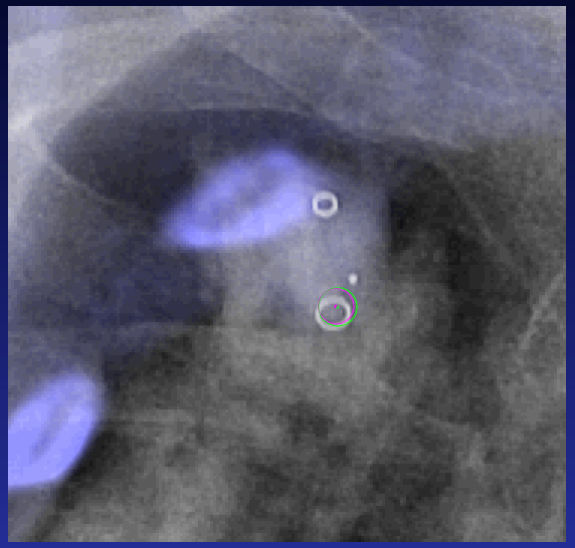
Typical time span

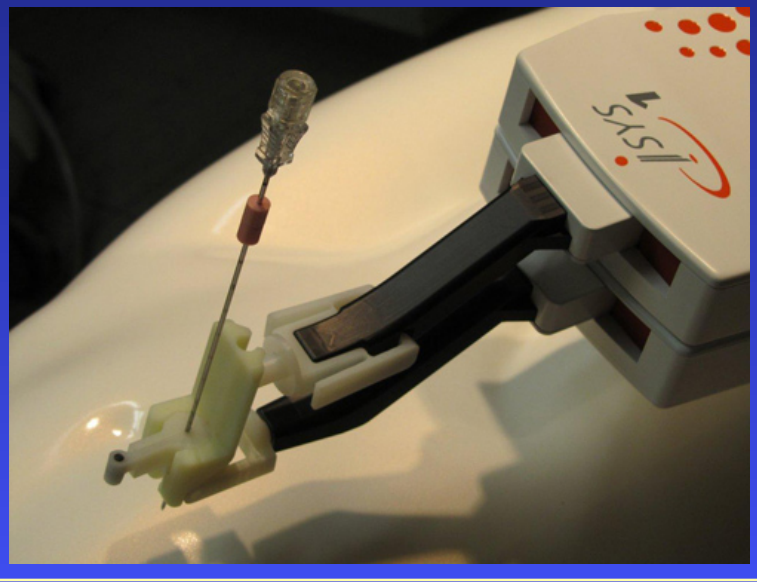
Imaging	10 min
Planning	10 min
Targeting	5 min/needle
Monitoring/controlling	10 min
Ablation	25 min
Finishing up	10 min
Total	~90 -120min

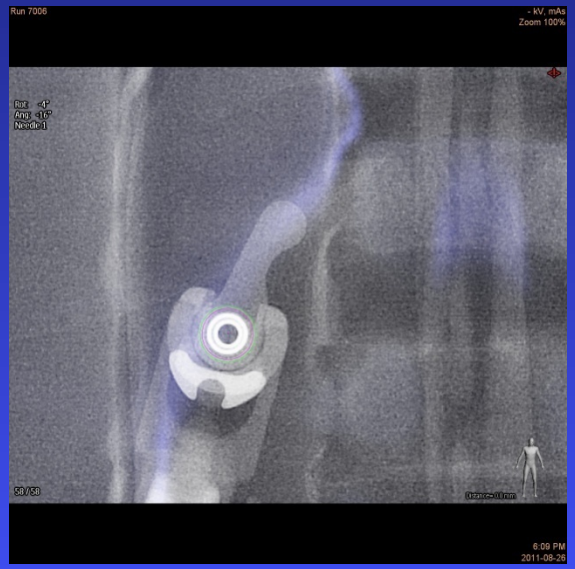
New developments

Robot assisted needle placement



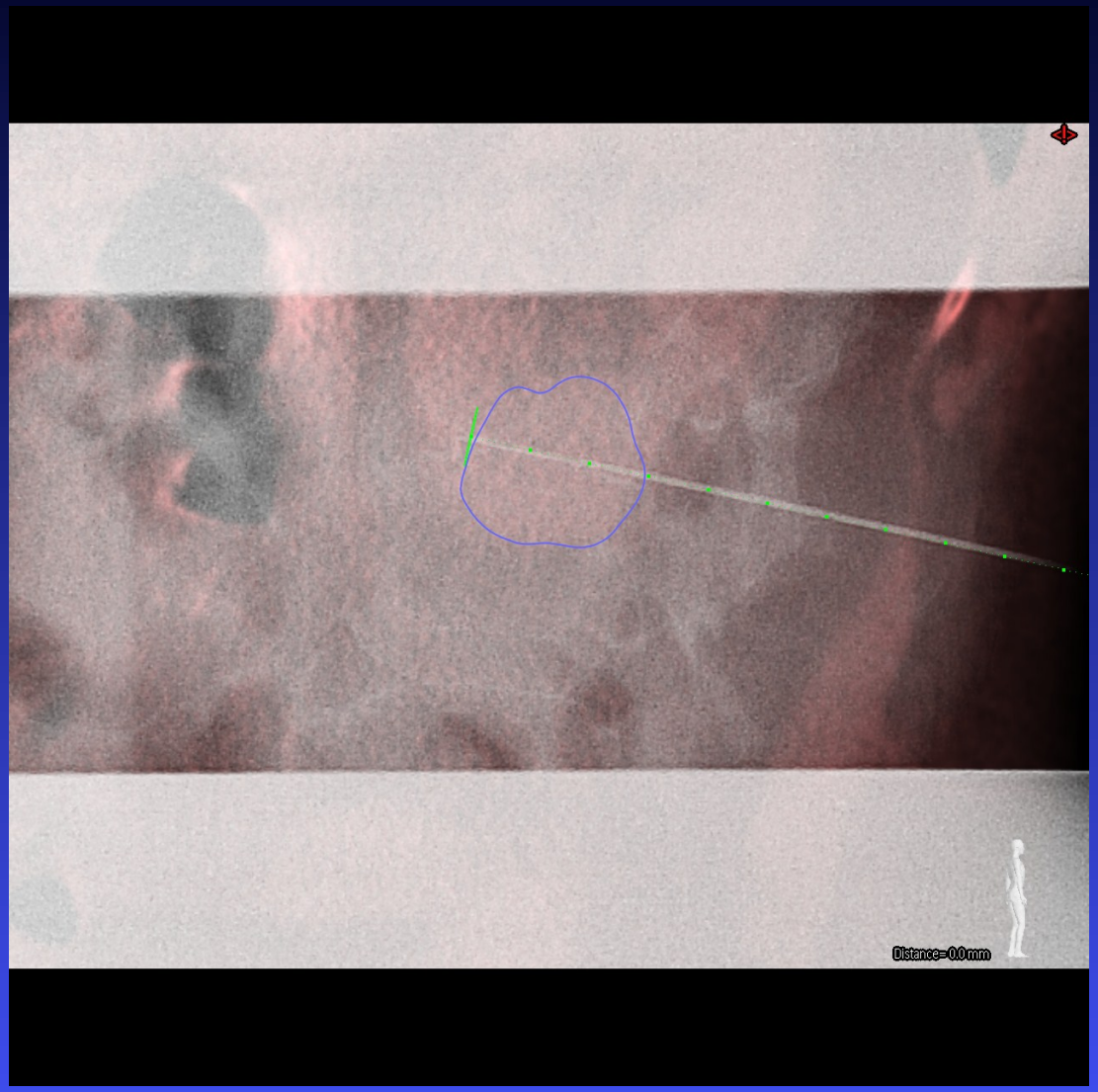






iSYS Medizintechnik, GmbH, Austria

Clinical example

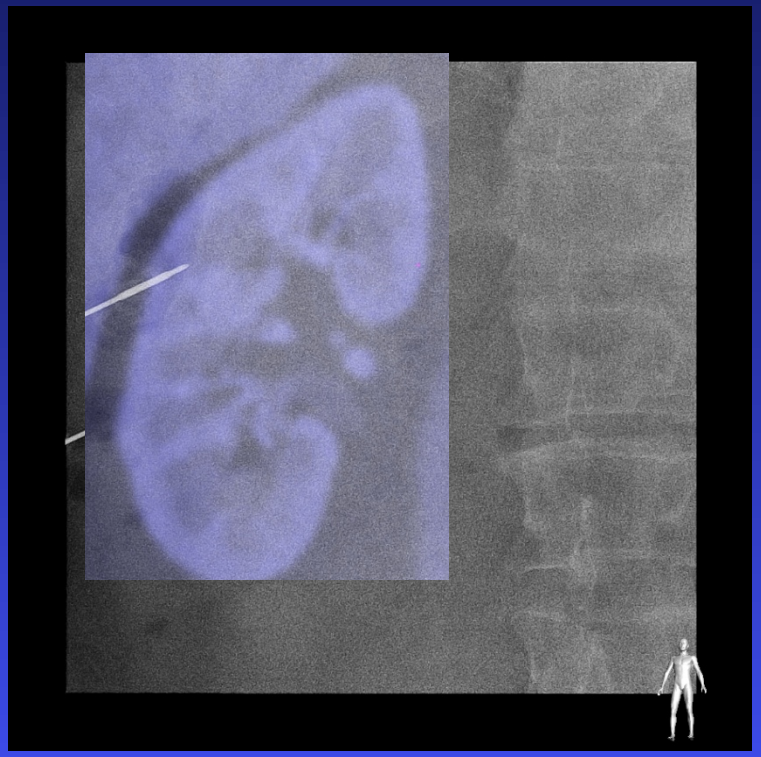


Movement compensation techniques

- General anaesthesia
- Patient compliance / devices
- Active compensation (fiducials? EM?)

Movement compensation techniques

- Computer techniques
- Feedback techniques

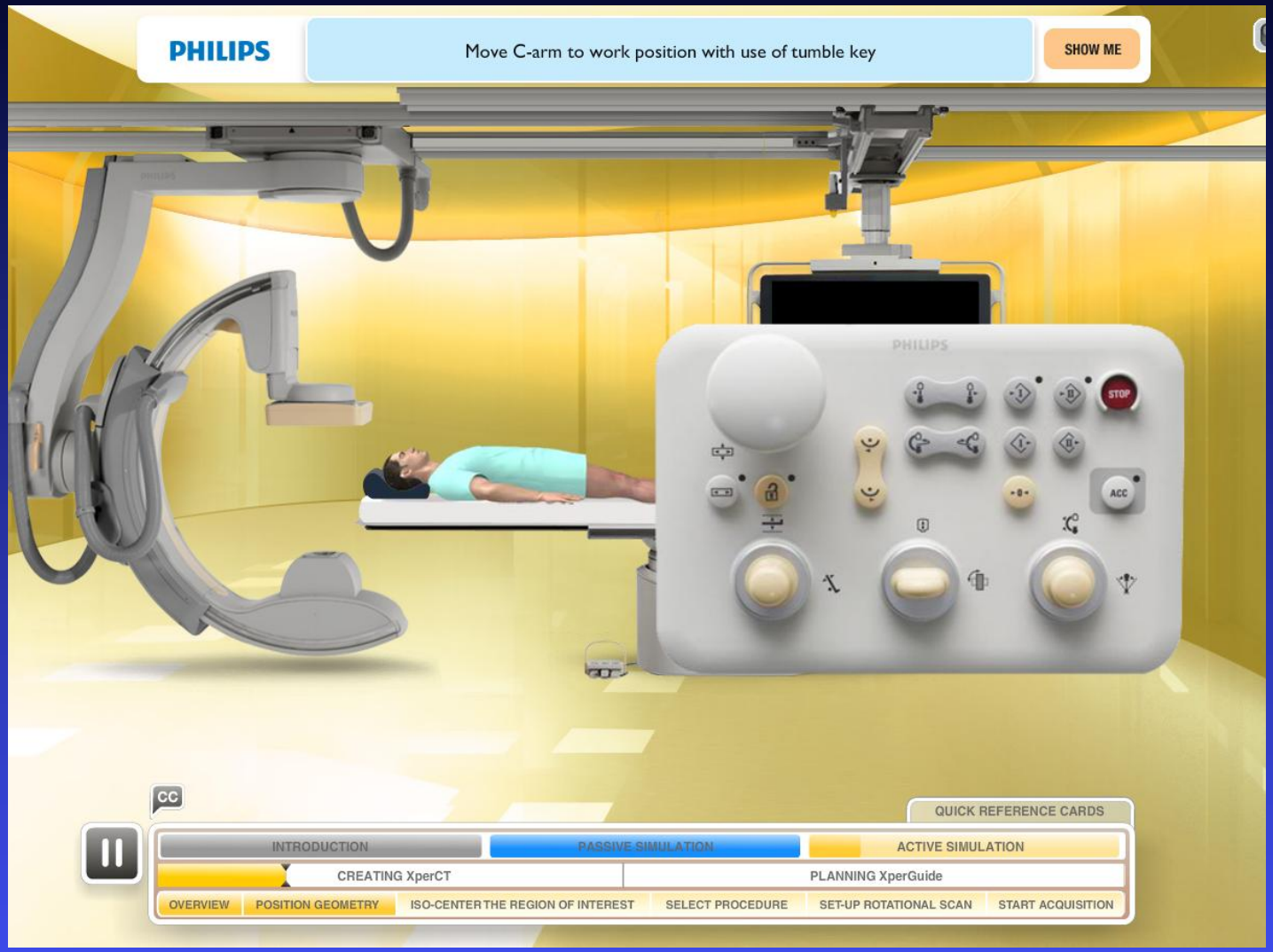


New technologies

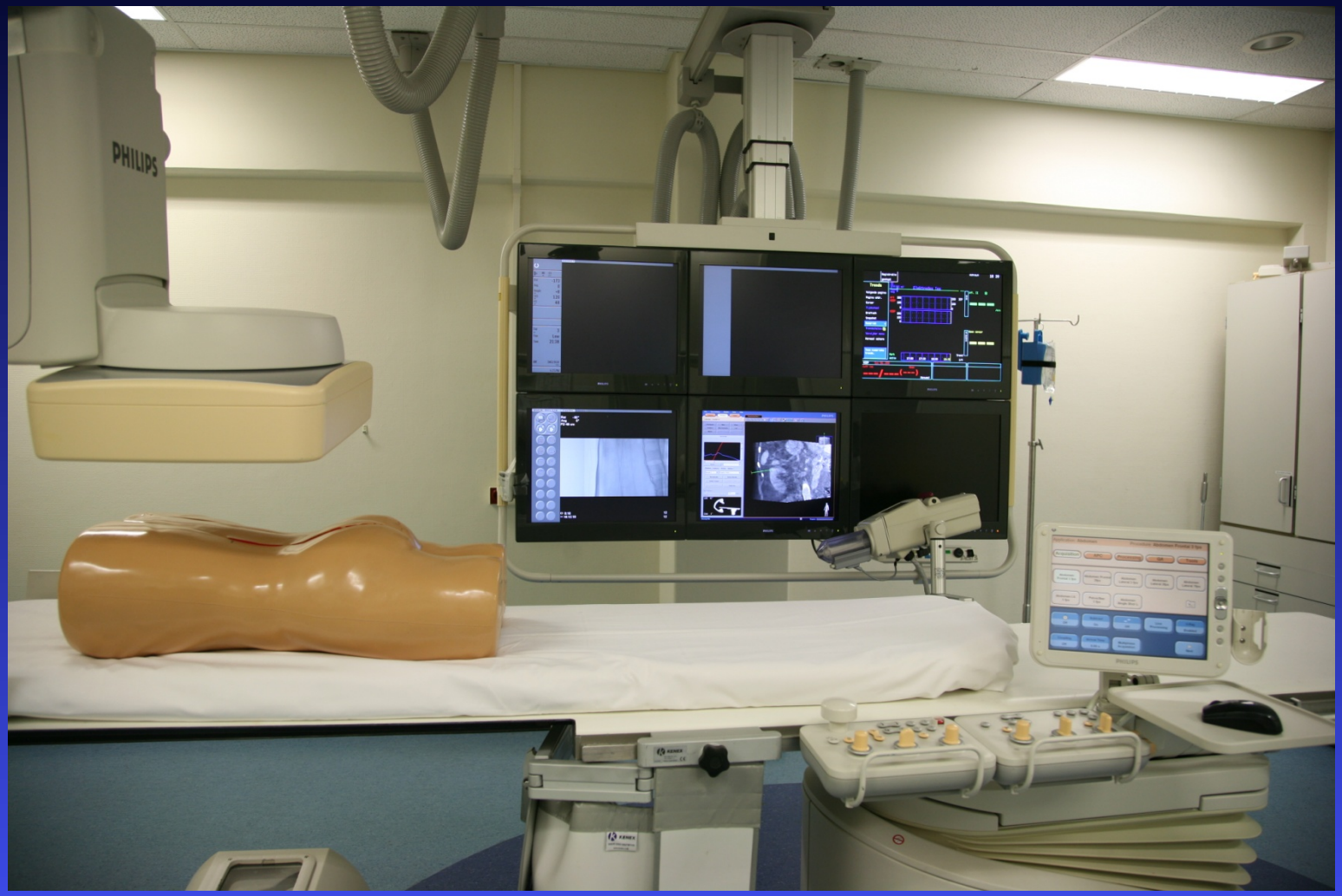
- New skills
- New equipment

- Need for education & workshops
- Interventional oncology suite of the future
- Integrated table side planning
- Multimodality approach (CT, MR, US and fluoroscopy)

E-learning


PHILIPS
Move C-arm to work position with use of tumble key
SHOW ME
STOP
ACC
CC
QUICK REFERENCE CARDS
INTRODUCTION
PASSIVE SIMULATION
ACTIVE SIMULATION
CREATING XperCT
PLANNING XperGuide
OVERVIEW
POSITION GEOMETRY
ISO-CENTER THE REGION OF INTEREST
SELECT PROCEDURE
SET-UP ROTATIONAL SCAN
START ACQUISITION

Phantom training



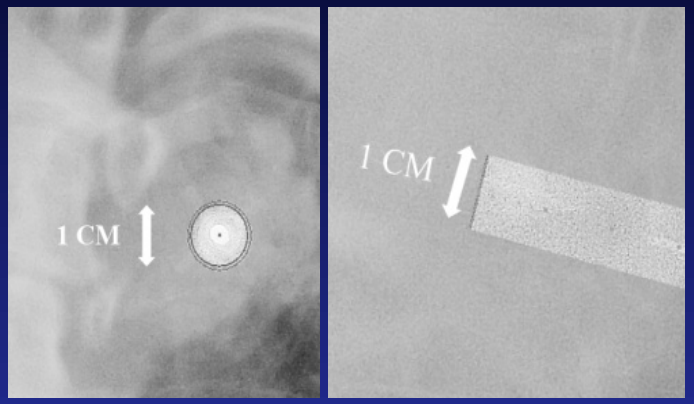
Intervention suite of the future

2011 St. Antonius Hospital Nieuwegein, The Netherlands

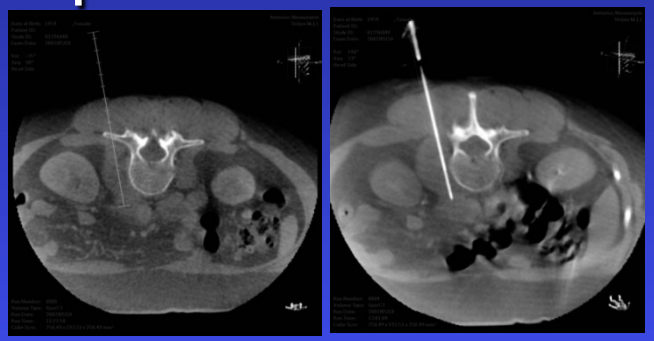
Conclusions

Overall results

- Currently over 800 procedures
- 100% technical succes in first 145 cases



- 91.4% histopathological diagnosis
- 4.9% minor self-limiting complications
- 1 pneumothorax



Braak, van Strijen Am. J. Roentgenol., May 2010; 194: W445 - W451.

Conclusions

- New interventional techniques
- Easy to use, high accuracy
- Both diagnostic and therapeutic
- Less dose compared to CT

- Hybrid solutions for complex cases
- CBCT for registration

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